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CONTENTS

For Announcements, etc., see General Index

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THE MAINLAND GENERA OF AMERICAN OLEACININAE

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This paper elaborates the anatomical details, on the oleacinine mollusk genera *Oleacina, Streptostyla, ·Euglandina,* and *Pittieria,* which already have been outlined briefly in the form of a key.[1] It is founded on dissections of preserved animals, which, with the exception of *Pittieria chiriquiensis,* were personally collected, and all which still remain in the author's possesson.

The following generic and subgeneric names, which have been proposed for living Oleacininae, are listed in order of priority:

Oleacina Röding (1798), *Polyphemus* Montfort (1810, preoccupied), *Glandina* Schumacher (1817), *Pfaffia Behn* (1845, nomen dubium), *Streptostyla* Shuttleworth (1852), *Varicella* Pfeiffer (1855), *Melaniella* Pfr. (1859?), *Chersomitra* Martens (1860), *Strebelia* Crosse et Fischer (1868), *Euglandina* C. & F. (1870), *Salasiella* Strebel (1877), *Glandinella* Pfr. (1878), *Boltenia* Pfr. (1881), *Poiretia* Fischer (1883), *Pichardiella* Fischer (1887), *Oryzosoma* Pilsbry (1891), *Pittieria* Martens (1901), *Sigmataxis, Biangulaxis* (?), *Varicellidea, Varicellopsis, Varicellula, Varicellaria, Varicellina,* and *Laevaricella* Pilsbry (June 1907), *Laevoleacina* Pils. (Aug. 1907), *Rectoleacina, Streptostylella, Peteniella,* and *Varicoturris* Pils. (Dec. 1907), *Laeviglandina, Varicoglandina,* and *Flavoleacina* Pils. (1908), *Eustreptostyla* H. B. B. (1927), *Streptostylops* Pils. (1933), *Costavarix* and *Euvaricella* H. B. B. (1935), *Perpusilla* H.B.B. (Feb. 1941), *Vagavarix* and *Boriquena* H. B. B. (July 1941), *Singleya, Cosmomenus, Guillarmodia, Ghiesbreghtia, Proameria,* and *Shuttleworthia* H.B.B. (Oct. 1941).

In the following synoptic outline of the American genera of Oleacininae and their subdivisions, each subgenus or section is followed by its type

[1] Nautilus 55: 52-55 (1941).

species, in parentheses. Also, if the anatomy of a group or of a type species is still unknown, its name is followed by an asterisk (*), which indicates that its exact systematic position may still be dubious.

1. VARICELLA [2], subgenera MELANIELLA [sections *Melaniella* s.s. (*V. acuticostata*) + *Pichardiella* (*V. pichardi**) and *Glandinella** (*V. poeyana*)], VARICELLA s.s. [sections *Costavarix* (*V. mandevillensis*), *Varicellula* (*V. blandiana*), *Varicellaria* (*V. procera*), *Euvaricella* (*V. similaris*), and *Varicella* s.s. (*V. leucozonias*)], VARICELLIDEA* [s.s. (*V. peruviana*) and *Varicellopsis* (*V. texta*)], VARICELLINA (*V. curvilabris**), and VAGAVARIX (*V. portoricensis*).

2. SIGMATAXIS [2] (*S. laeviusculus*).

3. LAEVARICELLA [2]: subgenera LAEVARICELLA s.s. (*L. semitarum**) and BORIQUENA (*L. glabra*).

4. OLEACINA (?): subgenera OLEACINA* s.s. (*O. voluta*) + *Glandina* + *Boltenia* + *Polyphemus* (*O. flexuosa*), SALASIELLA [3] [sections *Perpusilla* (*O. perpusilla*) and *Salasiella* s.s. (*O. joaquinae*)], LAEVOLEACINA (*O. oleacea straminea*), and FLAVOLEACINA (*O. mülleri*).

5. STREPTOSTYLA: subgenera RECTOLEACINA (*S. cubensis**), STREPTOSTYLOPS* (*S. mira*), EUSTREPTOSTYLA (*S. nicoleti*), STREPTOSTYLA s.s. [sections s.s. (*S. streptostyla*) and *Chersomitra* (*S. nigricans**)], and PETENIELLA* (*S. ligulata*).

6?. ORYZOSOMA* (*O. tabiense*).

7?. STREBELIA (*S. berendti*).

8. EUGLANDINA: subgenera VARICOTURRIS [sections *Streptostylella** (*E. botteriana*), *Ghiesbreghtia* (*E. flammulata*), and *Varicoturris** s.s. (*E. dubia*)], VARICOGLANDINA (*E. monilifera**), GUILLARMODIA [sections s.s. (*E. pupa*) and *Proameria* (*E. saxatilis*)], and EUGLANDINA s.s. [sections *Cosmomenus* (*E. cumingii*), *Singleya* (*E. singleyana*), and *Euglandina* s.s. (*E. aurata lignaria**)].

9. PITTIERIA (?): subgenera PITTIERIA* s.s. (*P. bicolor*), SHUTTLEWORTHIA (*P. arborea*), and LAEVIGLANDINA (*P. underwoodi**).

The genera of Oleacininae fall into 3 quite distinct tribes: Varicellarum (*Varicella, Sigmataxis, Laevaricella*), Streptostylarum (*Oleacina, Streptostyla*, and perhaps *Oryzosoma, Strebelia*), and Euglandinarum (*Euglandina, Pittieria*). The *Varicella*-tribe now appears to be purely Antilleal (relict endemism?). Cuban and Jamaican species have the most primitive radulae (small teeth with ectocones), but the Puerto Rican and Lesser Antillean ones develop, especially in *Laevaricella*, as specialized dentures as do the primitive groups of the other tribes. In opposition to this, *Varicella* has the best developed epiphallus, which is progressively lost in the other tribes. Early in their history, the groups Streptostylarum and Euglandinarum seem to have diverged from some common ancestor, presumably on the mainland.

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[2] Anatomy and keys in Nautilus 55: 24-30, and Nautilus 49: 21-22.

[3] Anatomy and key in Nautilus 54: 80-84.

Oleacina and *Streptostyla* retain triangular kidneys and distant mantle-lappets like *Varicella*, but seem to have primitively acquired a lateral penial branch and greatly reduced the penial end of the epiphallus; the branch disappears in *Flavoleacina* and in *Eustreptostyla;* both structures are lost in *Streptostyla* s.s. This *Streptostyla*-tribe still ranges from Central America to Cuba and Haiti, and thus differs from the Spiraxinae, which mainly passed to Jamaica. The *Euglandina*-tribe seems to be restricted to the mainland. *Varicoturris* and *Varicoglandina*, in their long epiphalli and brightly banded shell-varices, resemble *Varicella* more than does any known Streptostylarum group, but have the unique ligulate Euglandinarum kidney with its divergent ureter, and continuous mantle-lappets. Peculiarly enough, although the section *Euglandina* s.s. is the most specialized group in the genus in regard to its obsolete epiphallus and obsolescent radular central, it alone exhibits the primitive position of the right eye retractor in the penioviducal angle. *Pittieria*, although very similar to the genus *Euglandina* in most structures, is the only agnathomorph group, and one of the few pulmonate lines, that is known to have developed a secondary duct between the anterior male and female organs.

In all the groups of Oleacinidae, the shells seem to have developed towards both truncate (achatinoid) and twisted (more bulimoid) columellae. In the Spiraxinae, the most primitive group (*Miraradula*) has an intermediate, undifferentiated columella, and the divergent lines exhibit gradual steps toward extremes of truncation (*Pseudosubulina*) or twist (*Spiraxis*), which seem to be almost equally successful. In the *Varicella*-tribe, *Melaniella* also has a rather simple columella, but intergrades only with the truncate line (*Varicella, Laevaricella*), which ranges widely and contains more species than does the twisted stock (*Sigmataxis*). *Oleacina* (truncate) and *Streptostyla* (twisted) seem to represent almost parallel lines, both with moderate speciation, but without truly intermediate columellae. Finally, in the *Euglandina*-tribe, the columella is almost always decidedly truncate, but may be markedly twisted as well (*Varicoturris* and *Shuttleworthia*).

Oleacina? (Laevoleacina) solidula (Pfeiffer) Plate I, fig. I.

Oleacina solidula (Pfr.), Pils., 1907. Man. Conch. 19: 140; (1908) xviii, pl. 35, fig. 8, pl. 36, figs. 16, 19, 20 (anatomy).

My animal was collected June 1926, at Marianao, Cuba. Pilsbry has also dissected *O. oleacea straminea* (Desh.) and *O. oryzacea* (Orb.); the radula of the last approaches that of *Salasiella* s.s. *Salasiella, Laevoleacina*, and *Flavoleacina* appear to be congeneric, but the anatomy of *Oleacina* s.s. is still unknown and its shell also resembles that of *Laevaricella* (subgenus *Boriquena*).

Animal like *Salasiella* but foot pallid; tail flattened above, with median groove distinct near base and with tip pointed. Lung dark anteriad and along principal vein; kidney 1.2 pericardium. Ovotestis (omitted from

fig. 1) with 7-8 bifid or trifid alveoli; carrefour (X) shallowly imbedded. Epiphallus (E) internally with longitudinal ridges; without "accessory sac" (Pilsbry's probably caused by unequal contraction of retractor, which surrounds its penial end); entering, without verge, considerably below penial apex (PC). Penis (P) internally with 4 pilasters in apical caecum (PC), two of which (Cf. fig. 4), including one pierced by vas entrance, extend up lateral branch (PL), so groove between them ends in shallowly concave base of solid tip (PA). Radula with 33 (Pilsbry) to 39 teeth in 47 rows; centrifugals very slightly increasing out to 3rd or 4th; ribbon 3.8 mm. long.

Oleacina? (Flavoleacina) pethionis (Weinland) Plate I, figs. 2-3.

Oleacina pethionis (Weinland), Pilsbry, 1907, Man. Conch. 19: 134. [Cf. *O. mülleri*, op. cit., 1908: xix, anatomy.]

An animal collected Sept. 15, 1933, near Port-au-Prince, Haiti, and in which the genitalia were still slender, has been dissected. *O. pethionis* is included in *Flavoleacina* although its penis lacks the peculiar "appendix" of *O. mülleri*. In any case, it proves that the divergences in structure among the Antillean species of the genus are much greater than the differences between *Laevoleacina* and *Salasiella*. Parallel modifications of the penis in *Oleacina* and *Streptostyla* seem more probable than would a close relationship between *Flavoleacina* and *Eustreptostyla*.

Like *O. solidula* but tail with mid-dorsal sulcus. Epiphallic sac (E, fig. 2) internally with diagonal ridges. Penial retractor (PR) arising high on diaphragm. Penis (P) externally simple; internally with subapical stimulator papilla (PP) near apical vas entrance, and with weak longitudinal folds. Radula (fig. 3) with 43 teeth in 47 rows; inner ones subequal; ribbon 4.7 mm. long.

Streptostyla (Rectoleacina?) physodes (Shuttleworth) Plate I, fig. 4.

Streptostyla physodes (Sh.), Strebel, 1877, Beitrag Kennt. Fauna Mex. Land u. Sussw. Conch., Theil III: 22, pl. iv, fig. 1-10, pl. vii, fig. 1, anatomy (not fully mature); Tryon, 1885, Man. Conch. I: 42.

The figured animal was obtained near Córdoba, Mexico. The soft parts of the Cuban type species of *Rectoleacina* are unknown, but its shell has similarly prominent spire and varices to the Mexican species, which are very close, in their anatomy, to *Laevoleacina*. *Rectoleacina* is tentatively included in *Streptostyla*, because, although anatomically rather distinct, its shell characters are so vague that the Mexican species, at least, could not be separated out of *Streptostyla* with accuracy. Those of *Streptostylops* seem even more trivial, but, because it comes from the island of Haiti, it may prove to deserve subgeneric rank. The groove in the penial pilaster and diverticular papilla of *S. physodes* looks as if it might act as a seminal channel; the arrangement is similar, but less striking, in *Salasiella* and *Laevoleacina*.

Animal like *S. streptostyla* but without median stripe; base of tail flattened above, with fair middle sulcus. Lung with many black blotches (also

apex); twice base or 2.2 kidney (r, fig. iv-5) [4], which is as long as its base or 1.6 pericardium (c). Prostate (pr, fig. iv-6) ¾ uterine length. Epiphallus (vd; E, my fig. 4) with elongate sac, which internally has axial ridges, that apically break into papillae; entering (EP) groove in pilaster (PP) through penial retractor (rp; PR) and apex. Penis (p) internally spongy, with long, deeply grooved pilaster (PP) from apex of epiphallic branch (PE) to tip of papilla (PQ) in apex of diverticulum (gm, PL). Radula (fig. vii-1) with 25 to 27 (mine) teeth in 55 rows; 3rd (longest) 1.4 length of 1st; ribbon 7 mm. long (12.5 mm. shell).

Streptostyla (Rectoleacina ?) lymneiformis (Shuttleworth) Plate I, figs. 5-6.

Streptostyla lymneiformis (Sh.), Tryon, 1885, Man. Conch. 1: 49.

The figured animal comes from Sumidero, Mexico.

Like *S. physodes* but foot pale. Lung with few brown spots anteriad. [Ovotestis and spermathecal sac seen only in a younger animal.] Penis (fig. 5) with longer base (P) and lateral branch (PL); internally with very similar pilaster, but groove not reaching diverticular apex, which lacks papilla. Radula (fig. 6) with 113 smallish teeth in 113 rows; inner ones subequal; ribbon 6 mm. long (18 mm. shell).

Streptostyla (Eustreptostyla) nicoleti (Shuttleworth) Plate I, fig. 9.

Streptostyla nicoleti (Sh.), form B, Strebel, 1877, Beitrag III: 14, pl. vii, fig. 3, Orizaba.
Streptostyla nicoleti subovata Martens, 1891, Biol. Central-Amer.: 85.

Animals from near Sumidero, between Córdoba and Orizaba, Mexico, have been dissected. Strebel's figures of the anatomy of the next subspecies are utilized in the following description (see footnote 4).

Animal like *S. streptostyla* but foot exceptionally broad, grayish; tail tip rounded; labial palps (tl, fig. iii-5) longer than broad. Lung (fig. iii-2) fairly dark, especially along veins; twice base or 2.5 kidney (r) which has narrow anterior lobe (missed by Strebel) and is about .8 as long as base or almost twice pericardium (c). Ovotestis (gh) with 9 fans of alveoli, imbedded .4 to .9 of apical liver lobe. Free oviduct 3 times as long as vagina. Prostate (pr, fig. iii-3) attached along basal half of spermoviduct. Epiphallic swelling (upper vd) abrupt basally but attenuate apically; internally spongy, with oblique folds connected by lower ones at right angles; nerve from pedal ganglion. Penial retractor arising on diaphragm; inserting around epiphallus but continuing to penial apex (as usual). Penis (p) with hyperphallic sac, which internally (P′, my fig. 9) shows 3 high folds with epiphallic entrance (EP) through largest; penis proper (P) containing large stimulator (PP), free about half its length; nerve from cerebral ganglion. Atrium opening 3 mm. behind inferior tentacle. Salivary glands (s) clasping oesophagus. Radula (fig. vi-1) with 171 teeth in 101 rows; inner zones small and almost subequal; ribbon 10 mm. long (25 mm. shell).

[4] In this description and some of the following, use is made of Strebel's (op. cit.) figures, which are preceded by the Roman numerals of his plates, and of his labels, which are in minuscule letters in contrast to the capitals on my plates.

Streptostyla nicoleti atypica H. Burrington Baker

Streptostyla nicoleti (Sh.), form A, Strebel, 1877, Beitrag III: 13, pl. vii, fig. 2, pl. iii, figs. 1-10, pl. vi, fig. 1, anatomy.

Streptostyla nicoleti atypica H.B.B., 1941, Nautilus 55: 55.

The immature type from Necaxa has been dissected.

Like typical form but: More brownish, darker anteriad. Lung darker. Genitalia (after Strebel) with free oviduct much shorter and penis slenderer and longer (may be differences in contraction). Stimulator (immature) with much shorter free tip. Radula with 102 (mine) to 111 teeth in 88 rows; ribbon 8.5 mm. long (30.6 mm. shell).

Streptostyla (s. s.) streptostyla (Pfeiffer)

Streptostyla pfeifferi Crosse, Tryon, 1885, Man. Conch. 1: 47.

Streptostyla coniformis (Shuttl.), Strebel, 1877, Beitrag III: 15, pl. iv, figs. 11-14, pl. vi, fig. 3, anatomy.

Both forms, from Sumidero and Córdoba, Mexico, have been dissected. The peculiarly high origin of the penial retractor is a unique feature.

Animal like *Salasiella* but: Foot quite dark above; head with reddish median line bordered by white sulci; tail pointed, without distinct pedal groove. Mantle collar pale; palatal ("left") mantle lappets widely separated (like in *Varicella*); umbilical lobe obsolete. Lung (fig. iv-12) [5] white with few black spots; minor venation prominent; almost 2.5 times its oblique base or thrice kidney (r), which is .8 its base or 1.2 pericardium (c). Ovotestis (gh, fig. iv-13) of few subdivided alveoli. Spermatheca caught in aorta but recurved; small ovoid sac imbedded at left of first of S-loops of intestine. Prostate (pr) slenderer, $\frac{4}{5}$ length of uterus and closely attached; continued apically by seminal groove (Cf. DS, my figs. 5 or 8). Vas deferens (vd) simple, looping apically through posterior wall of body cavity, far above which it enters penial retractor (rp; arising from sutural side of mantle near ovotestis); gradually enlarging, near where it reënters haemocoele, into a simple penis (p), that contains 5 axial folds. Radula (fig. vi-3) with 45-49 (mine) to 53 teeth in 53 rows; 6th (longest) 1.1 times length of 1st; ribbon 7 mm. long (22 mm. shell). Oesophagus (oe, fig. iv-14) entering buccal bulb above anterior end of radula.

Streptostyla (Chersomitra) irrigua (Shuttleworth) Plate I, figs. 7-8.

Streptostyla irrigua (Sh.), Tryon, 1885, Man. Conch. 1: 46.

The dissected animal comes from near Córdoba, Mexico. I suspect my only radula is deformed, since in most pulmonates the outer teeth diminish in size, but the only internal evidences are the slightly thickened margins of the basement membrane.

Animal like *S. streptostyla* but: Darker; lung dark anteriad and along veins. Ovotestis with 6 fans of alveoli. Prostate (DG, fig. 8) along basal .6 of uterus (UT). Penial retractor (PR) arising high on diaphragm, surrounding vas deferens (D), which enters through a small teat-shaped papilla (about .06 length of penis). Penis (P, partly everted before dissection)

[5] See footnote 4.

internally with 8 low axial folds, which disappear when everted and are broken by V-shaped processes near apex. Radula (fig. 7) with 11 teeth in 72 rows; 5th (outermost) twice as long as first; ribbon 15.5 mm. long (23.5 mm. shell).

Streptostyla irrigua quirozi Strebel

Streptostyla quirozi Str., 1877, Beitrag III: 21, pl. viii, fig. 3, Coatepec (immature).
Streptostyla shuttleworthi (Pfr.), Strebel, 1877: 18, pl. viii, fig. 9, Misantla; pl. v, figs. 1-10, pl. vi, fig. 2, anatomy (slightly immature).

The radula of a juvenile animal (10.5 mm. shell) from Necaxa, Mexico, seems to prove that the great enlargement of 5th and 6th radular teeth comes quite late in development.

Like *S. irrigua* but: Paler on sides. Genitalia (from fig. v-6) [6] with subequal free oviduct and vagina, and with vas entering retractor (rp) farther from penis (p). Radula (from fig. vi-2d) with 27(?) teeth; 6th (longest) 2.4 times length of 1st. Juvenile (mine) with 27-29 teeth in 51 rows; ribbon 8 mm. long; posterior rows (last formed) similar to adult but anterior rows (laid down when younger) with inner teeth subequal.

Euglandina (Ghiesbreghtia) flammulata H. Burrington Baker   Plate I, figs. 10-11.

Euglandina flammulata H.B.B., 1941. Nautilus 55: 56, pl. 5, figs. 10-12.

The animal of this or a very closely related form (shell broken) comes from Sumidero, Mexico. *Ghiesbreghtia* is a section of the subgenus *Varicoturris*.

Like *E. stigmatica* but: Lung with quite close black network (also in type); minor veins indistinct. Ovotestis, duct, and albumen gland not seen. Vas deferens (D, fig. 10) with long epiphallic swelling (E; cavity indicated by dotted lines). Penis (P) internally with about 15 wavy axial plicae. Radula (fig. 11) with 67 teeth in 51 rows; 4th or 5th (longest) 1.5 length of 1st; ribbon 1.4 mm. long.

Euglandina (Varicoglandina) stigmatica (Shuttleworth)   Plate 2, figs. 12-13.

Oleacina stigmatica (Sh.), Tryon, 1885, Man. Conch. I: 28.

The figured animal is from Sumidero, Mexico. In its soft parts, especially the epiphallus, *E. stigmatica* seems much more closely related to subgenus *Varicoturris* than to *Guillarmodia* or *Euglandina* s.s.

Animal like *E. vanuxemensis* but: Foot slender, pale; basopalatal ("posterior left") mantle lappet increasing in height but apparently not otherwise demarcated from short angulopalatal ("anterior") one. Lung dead white, with some dark pigment along fairly distinct veins. Ovotestis not seen. Free oviduct (UV, fig. 12) internally with 11 axial plicae, which unite in vagina (V) to become atrial thickenings. Prostate (DG) $\frac{2}{3}$ as long as uterus. Penis (P) internally with anastomosing, mainly transverse zigzag folds, passing near base into dorsal and ventral thickenings, which continue into atrium, that opens halfway back on head. Radula (fig. 13) with 74 teeth in 46 rows; central with moderately long cusp; 6th (longest) 1.5 times

[6] See footnote 4.

length of 1st; ribbon 5 mm. long (17.5 mm. shell). No " crop " observed. Right eye muscle free from genitalia.

Euglandina (Guillarmodia) pupa H. Burrington Baker Plate 2, figs. 14-15.

Euglandina pupa H.B.B., 1941, Nautilus 55: 57, pl. 5, figs. 8-9.

Animals of the type lot, from Atoyac, Mexico, have been dissected.

Like *E. stigmatica* but: Darker above; umbilical shell-lobe evident. Lung closely mottled with brown; minor veins indistinct. Ovotestis with 5 bifid or trifid alveoli. Prostate (DG, fig. 14) .6 length of uterus. Free oviduct (UV), vagina (V), and penis (P) internally with 8 wavy axial folds. Vas deferens (D) without epiphallic swelling. Atrium (Y) opens $\frac{2}{3}$ way back on head. Radula (fig. 15) with 57 teeth in 50 rows; 5th (longest) 1.7 times length or 1st; ribbon 2.5 mm. long.

Euglandina (Proameria) saxatilis H. Burrington Baker Plate 2, fig. 16.

Euglandina saxatilis H.B.B., 1941, Nautilus 55: 57, pl. 5, figs. 2-3.

The type, from below Necaxa, Mexico, has been dissected. *Proameria* is intermediate between *Varicoglandina* and *Euglandina* s.s. in its soft parts as in its shell. Strebel has dissected *E. conferta* (op. cit., p. 32, figs.) and *E. polita* (p. 48, figs.), which are included in *Proameria,* although both species have much shorter vaginae and the positions of their right eye muscles are not known. Since he had but one radula of *E. polita,* the absence of a central may have been abnormal.

Animal like *E. stigmatica* but: Head pale fuscous above. Lung with few black spots anteriad. Ovotestis not seen. Long vagina (V) internally with axial plicae. Prostate .6 length of uterus. Penial retractor (PR) arising high on diaphragm. Penis (P) internally with 11 axial folds in lower half. Vas deferens (D) not much enlarged. Atrium opens $\frac{2}{3}$ way back on head. Radula with 91 teeth in 51 rows; 6th (longest) 1.3 length of first; ribbon 5.5 mm. long (19.2 mm. shell).

Euglandina (P.) cordovana (Pfeiffer)

Oleacina cordovana (Pfr.), Tryon, 1885, Man. Conch. 1: 26.

A young and broken animal from Sumidero, Mexico, has been dissected.

Like *E. stigmatica* but: Darker above; lung with transverse black streaks; minor venation weak. Genitalia still slender; vas deferens not enlarged; atrium opening near visceral stalk. Radula with 84 teeth in 49 rows; 6th (longest) 1.5 times length of first; ribbon 7 mm. long (22 mm. shell).

Euglandina (Cosmomenus) cumingii (Beck) Plate 2, figs. 17-18.

Euglandina cumingii (Beck), H.B.B., 1925, Occ. Papers Mus. Zool. Univ. Mich. 156: 43, pl. 11, figs. C, D.

The figured animal comes from near La Fria, Venezuela (station 41). The origin of the penial retractor in *Cosmomenus,* so similar to that in *Ancotrema,* adds another to the many parallelisms between the Oleacininae and the Haplotrematidae.

Animal like *E. vanuxemensis* but: Tail narrowly rounded; lung flecked with black. Gonad not seen. Free oviduct (UV, fig. 17) and vagina (V) internally with axial plicae. Penial retractor (PR) arising near and connected by muscle strands to left side of columellar tail fan; passing around dorsal to oesophagus. Penis (P) small, internally with 7 axial folds. Atrium (everted) opening .3 way back on head. Radula (fig. 18) with 71 teeth in 39 rows; 11th (longest) 1.8 length of first; ribbon 15 mm. long. Right eye muscle free from genitalia.

Euglandina (Cosmomenus) cylindracea (Phillips) Plate 2, figs. 19-20.

Euglandina cylindracea (Ph.), Pilsbry, 1908, Man. Conch. 19: 198.

Animals from near Progreso, Yucatan, have been dissected.

Like *E. cumingii* but: Brownish above, with pale median band on head; lung with brown chevrons or rows of spots. Ovotestis with 8 fans of alveoli. Uterus still slender. Free oviduct (UV, fig. 20) with short but evident apical caecum. Penial retractor (PR) arising from left side of columellar muscle tail fan. Penis (P) large; basal half internally with 11 connected axial folds, which become zigzag transverse ones towards apex. Radula (fig. 19) with 75 teeth in 65 rows; central with slightly stronger cusp; 12th (longest) centrifugal 1.5 length of first; ribbon 11.5 mm. long (28.5 mm. shell).

Euglandina (Singleya) singleyana (W. G. Binney) Plate 2, figs. 21-22.

Euglandina singleyana (W.G.B), Pilsbry, 1907, Man. Conch. 19: 189.

The dissected animals were collected June 24, 1929, near New Braunfels, Texas.

Like *E. rosea* but: Brownish head darker near median pale stripe. Lung with variable brown spots or bands. Ovotestis with 5 conic lobes. Vagina (V, fig. 21) and lower third of free oviduct (UV′) internally with coarse axial folds, which are broken by transverse ones towards uterus. Penis (P) internally with 13 wavy axial plicae at base, which branch into 31 towards apex. Atrium opening near front edge of visceral stalk. Radula (fig. 22) with 71 teeth in 57 rows; 10th (longest) 1.6 times length of first; ribbon 13.5 mm. long. Right eye muscle free from genitalia.

Euglandina (Singleya) decussata (Deshayes) Plate 2, fig. 23.

Euglandina decussata (Desh.), H.B.B., 1923, Occ. Papers Mus. Zool. Univ. Mich. 135: 8.

The anatomy is based on an immature animal, which was collected in 1910 near Cuatotolapam, Mexico, and had been almost dried.

Like *E. singleyana* but: Darker, with 2 white sulci bordering mid-dorsal stripe. Lung mottled with black. Female organs immature; penis better developed. Radula (fig. 23) with 73 teeth in 43 rows; 5th or 6th (longest) 1.4 times length of first; ribbon 14.5 mm. long.

Euglandina (s. s.) rosea (Férussac)

Glandina truncata (Gmelin), Leidy in Binney, 1851, Terr. Air-Br. Moll. U. S., vol. 1: 202, 214, 231, pl. xiv, pl. xvi, fig. I (anatomy).

Euglandina rosea (Fér.), Pilsbry, Man. Conch. 19: xxvi, pl. 25, figs. 4, 8 (radula).

My animal of the form *minor* (W.G.B.) was collected in July on a shrub in Key West, Florida. Leidy's beautifully clear figures, which are a relief after Strebel's somewhat fuzzy ones, are utilized in the following notes.

Like *E. vanuxemensis* but: Pale, brownish above. Lung pattern (1, fig. xiv-I) as shown, but ureter opens in apical corner (27, fig. II, should be a sulcus). Ovotestis with 11 fans; duct (12 and 13) as usual. Uterus (18) longer; prostate along basal $\frac{3}{4}$. [My animal with free oviduct, which is simple and without internal folds, vagina (20) and penis more contracted than in Leidy's.] Penial retractor arising near base of uterus. Penis (15) internally with 8 wavy axial folds. Atrial opening (4, fig. I) $\frac{1}{3}$ way back on head. Radula with 69–73 teeth in 65 rows; 7th (longest) 1.3 times length of first; ribbon 8.5 mm. long. No constriction between " crop " and stomach (3, fig. II).

Euglandina (s. s.) truncata (Gmelin)

Euglandina truncata (Gm.), H.B.B., 1925, Occ. Papers Mus. Zool. Univ. Mich. 156: 41.

An animal from near Boquerón, Venezuela, (station 28) has been dissected.

Like *E. rosea* but: Free oviduct internally with axial plicae. Prostate over half length of uterus. Penis short ovoid, internally with weak thickening (cf. *E. vanuxemensis*) and 16 axial folds. Atrium opening .2 way back on head. Radula with 87 teeth in 64 rows; central almost cuspless; 6th or 7th (longest) 1.7 times length of first; ribbon 18.5 mm. long.

Euglandina (s. s.) vanuxemensis (Lea) Plate 3, fig. 24.

Glandina coronata (Pfr.), Strebel, 1877, Beitrag III: 45, pl. xi, fig. 3, anatomy. [Cf. also *G. sowerbyana* (Pfr.), Str., 1877; 35, pl. xi, fig. 1, pl. xv, fig. 1, pls. xvi-xxi, detailed anatomy.]

My figured animal is from near Pirámides, Mexico. Because Strebel has carefully figured the anatomy of *E. sowerbyana*, which is also closely related to the generic type (his form C), references [7] are made to his studies in my notes on *E. vanuxemensis*. Other species, probably of the typical section, dissected by Strebel, are *E. liebmanni* (p. 46), *E. coulteri* (+ *G. uhdeana*, p. 46), *E. sowerbyana estefaniae* (p. 45, figs.), *E. daudebarti miradorensis* (p. 33, figs.), and *E. daudebarti amoena* (p. 34, figs.), but in none except *E. sowerbyana* does he mention the position of the right eye muscle.

Animal like *Salasiella* but: Brownish, darker on top of head (fig. xv-1) [7]. Mantle collar (fig. xx-6) yellowish, with large parietal (" right ") mantle lappet, and low but extensive angulopalatal (" left anterior ") one, which overlaps basopalatal (" posterior "). Lung (figs. xxi-4, 5) closely mottled with dark; hindgut margin 6 times columellar border and twice base of kidney, which is ligulate, with a narrow anterior tongue along and about length of pericardium (c) but with broad base so oblique as to almost parallel hindgut and not quite reach it; minor veins prominent. Ureter expanded externally, with trabeculae on exterior wall; separated from kidney, except at

[7] See footnote 4.

ends, by triangular space of exposed lung wall; opening (not shown) near hindgut (i′) in apical corner of lung, but continued by broad groove (dr) to near pneumostome. Ovotestis with 5 lobes, each consisting of 2-6 fans of alveoli, covering half of basal half of apical liver lobe (much bigger than gh, fig. xvi-1); duct (GD, my fig. 24) forming many ampullae before entering albumen gland (GG, gal); carrefour (X) partly visible. Uterus (UT) short. Free oviduct (right od in fig. xvi-2?) has apical region (UV), internally with thin zigzag transverse folds, thick-walled middle part (UV′), internally with fine axial ridges, as also vagina (V), and a short ring (UV″) of shallow pouches, which internally show coarse folds; attached to body wall by many muscles (like in *Haplotrema*). Spermatheca (S, rs; cf. fig. xiv-2) imbedded like in *Streptostyla*. Prostate (DG) attached along basal .8 of spermoviduct; apical seminal groove without distinct alveoli. Vas deferens (D) without marked swelling; entering penial apex through retractor (PR), which arises above base of uterus. Penis (P) simple; internally with fine anastomosing ridges, and with low thickening in middle third, which causes undulations of thinner opposite side in preserved animals and is accompanied, on each side, by a narrow pilaster, that extends to penial apex. Atrium (Y) opening ⅓ way back on head (Cf. fig. xv-1). Radula (fig. xi-3) with 57–59 (mine) to 69 teeth in 57 to 40 rows; 8th (longest) centrifugal 1.7 times length of first; ribbon 24 mm. long (54.5 mm. shell). Oesophageal " crop " (v, fig. xvi-7) in body cavity, separated from stomach (v′) by slight constriction [at posterior wall of haemocoele; prominent in starved but erased in well-fed animals (Cf. Leidy's fig. of *E. rosea*)]. Intestine with large S-loops (Cf. fig. xiv-2). Central nervous system quite similar to that in *Haplotrema* [8]. Right eye retractor in atrial angle (fig. xix-2, p. 42).

Pittieria (Shuttleworthia) arborea H. Burrington Baker — Plate 3, figs. 25-28.

Pittieria arborea H.B.B., 1941, Nautilus 55: 59, pl. 5. figs. 13-15.

The figured genitalia are from the type locality, below Necaxa, Mexico, but the radula is from the nearby station 53. *Shuttleworthia* and *Laeviglandina* are distinct enough to rank as separate genera; in fact, the resemblances of the former to *Varicoturris* and of the latter to *Euglandina* s.s. may indicate that the genus *Pittieria*, as used here, is polyphyletic. However, their retention in one genus seems best, at least until the soft parts of more species, and especially of *P. bicolor*, are known.

Animal like *E. stigmatica* but: Darker on top of head and tip of tail. Parietal mantle lappet (MR, fig. 28) longer; angulopalatal one (MA) longest over pneumostome (LP) and on back of animal, and very shallowly

[8] Proc. Acad. Nat. Sci. Philadelphia 82: 418, pl. 34, fig. 9 (1930). In *E. sowerbyana*, Strebel evidently failed to remove the membranes around the ganglia, which are often quite opaque in large species, and thus failed to see the constrictions between the right and left cerebral (gc, fig. xix-2), pedal (xx-1, 2), and buccal (fig. xix-2, nerves 7-12) ganglia; did not distinguish between pedal and pleural connectives (cc); and completely missed the visceral ring (fig. xx-1, actually with nerves I–VIII). Large penial nerves from right pedal ganglion were shown (fig. xx-1, no true pedal nerves labeled), but contributions from right cerebral (which accompany inferior tentacular nerve in *E. vanuxemensis*) were omitted.

overlapping basopalatal (MP), which gradually increases in height; basal shell-lobe (LU) short. Lung lightly pigmented, with row of black spots along suture (also up to apex); minor veins weak; diaphragm dark. Kidney (K) with long (oblique basal) axis shorter; ureter (KD) more broadly expanded towards renal opening (KO). Ovotestis with 7 fans of alveoli. Free oviduct (UV, fig. 25) basally with sphincteric thickening, to which attaches band of very heavy muscles (UM), much as in *Haplotrema*. Vagina internally with shallow pouch (VG, fig. 26) honeycombed by openings of numerous clavate alveoli, which are grouped to form a conspicuous gland. Vas deferens (D) with slender branch (DU), which passes between alveoli to enter lower end of vaginal pouch; penial branch only slightly enlarged. Penial retractor (PR) arising near apical end of diaphragm. Penis (P) internally with 2 apical circles of large papillae with teat-like tips, followed by 3 pilasters and numerous axial folds. Atrium (Y) opens near visceral stalk. Radula (fig. 27) with 107–109 smallish teeth in 53 rows; centrifugals close ranked, with short cusps; 7th (longest, but subequal to long series) 1.3 times length of first; ribbon 4.5 mm. long (16.5 mm. shell). No " crop " observed. Right eye retractor free.

Pittieria (Laeviglandina) chiriquiensis (DaCosta) Plate 3, figs. 29-31.

Euglandina chiriquiensis (DaCosta), Pilsbry, 1908, Man. Conch. 19: 202.

The figured animal was collected April 15, 1937, on logs, elevation 4100 feet, near Santa Clara, Volcán de Chiriquí, Panamá, by Mr. David Bishop, who obtained another on bananas at 4000 feet. *P. chiriquiensis* seems quite closely related to *P. underwoodi* (Fulton), the type of the subgenus. The lateral bulb on its atrium looks like an accessory penis (perhaps for self-copulation).

Animal like *P. arborea* but: Foot stouter. Palatal (" left ") shell-lap (L, fig. 29) short but evident; basal lobe (LU) short; mantle lappets longer and more evenly expanded (like in *Euglandina* s.s., but longer) so angulo-palatal one (MA) extensively overlaps basopalatal (MP), which is basally continuous with parietal one (MR). Lung with oblique black streaks or rows of spots; minor veins moderately distinct; kidney and ureter more as in *Euglandina*. Ovotestis (G, fig. 30) with 6 fan-shaped lobes. Vas deferens (D) with atrial branch (DU), lumen of which begins as a small hole, but soon enlarges, becomes axially plicate, and opens into apex of bulbous atrial diverticulum (YL), that has thick walls, internally thrown into very coarse irregular folds; penial branch slenderer. Penial retractor (PR) arising $\frac{3}{4}$ way up uterus from diaphragm. Penis (P) internally with thickening like *E. vanuxemensis* and with zigzag axial plicae, which become irregular towards apex. Atrium (Y) opens $\frac{2}{3}$ back of head. Radula (fig. 31) with larger 57 teeth in 37 rows; central very short cusped (like in *Euglandina* s.s.); 8th centrifugal (more decidedly the longest) 1.5 times length of first; ribbon 2.5 mm. long.

Explanation of Plates 1 to 3

All figures are made with aid of camera lucida. Small numbers over hair-lines (scales) indicate their lengths in millimeters or decimals. The lines of right halves of radular transverse rows (T) show position of central (R) and widths of blocks of centrifugals (number at end of first block). The following abbreviations are used:

A, anus. AP, parietal angle.

D, vas deferens. DG, prostate. DS, seminal groove (above prostate). DU, branch to female side.

E, epiphallus. EP, entrance into penis.

G, gonad (ovotestis). GD, its duct. GG, albumen gland.

H, heart of pericardium. HG, hindgut. HV, principal pulmonary vein.

K, kidney. KD, ureter. KO, renal orifice. KS, urinary sulcus. KX, external ureteric opening.

L, palatal ("left") shell-lap. LA, apical (posterior) wall of lung and haemocoele. LP, pneumostome. LU, umbilical or basal shell-lobe.

MA, angulopalatal ("anterior left") mantle-lappet. MG, mantle glands. MP, basopalatal ("posterior left") mantle-lappet. MR, parietal ("right") mantle-lappet. MW, anterior wall of lung.

P, penis. PA, solid tip of lateral branch. PC, apical caecum. PE, epiphallic branch. PL, lateral branch. PP, stimulator or principal pilaster. PQ, papilla in lateral branch. PR, retractor.

R, radular central.

S, spermatheca. SS, its stalk.

T, line of right half of transverse row of radula.

UM, muscle bands from body wall. UT, uterus. UV, free oviduct.

V, vagina. VG, vaginal gland.

X, carrefour.

Y, atrium. YL, diverticulum.

Plate 1.—*Oleacina, Streptostyla, Euglandina.*

Fig. 1.—*O.* (*Laevoleacina*) *solidula* (Pfr.), Marinao, Cuba: Dissected genitalia (ovotestis omitted)

Figs. 2-3.—*O.* (*Flavoleacina*) *pethionis* (Weinland), Port-au-Prince, Haiti: 2. Ends of female gentalia and penis (retractor ⅜ omitted and part of wall removed to expose stimulator). 3. Radula; central with inner 3 centrifugals; also (T) line of half row with widths of central and blocks of 5 centrifugals.

Fig. 4.—*S.* (*Rectoleacina*) *physodes* (Sh.), Córdoba, Mexico: Penis opened lengthwise and spread out; with (P, PE) details of lining enlarged 3 times.

Figs. 5-6.—*S.* (*R.*) *lymneiformis* (Sh.), Sumidero, Mexico: 5. Dissected genitalia (ovotestis and spermatheca sac missing). 6. Radula; central with 2 inner centrifugals; also (T) line of half row with blocks of 7 teeth indicated.

Figs. 7-8.—*S.* (*Chersomitra*) *irrigua* (Sh.), Córdoba, Mexico: 7. Radula; central and complete half row of teeth. 8. Dissected gentalia (ovotestis omitted).

Fig. 9.—*S.* (*Eustreptostyla*) *nicoleti* (Sh.), Sumidero, Mexico: Penis and atrium opened lengthwise and spread out.

FIGS 10-11.—*E.* (*Ghiesbreghtia*) *flammulata* H.B.B., Sumidero, Mexico: 10. Dissected genitalia (gonad, duct, and albumen gland missing). 11. Radula; central with inner 4 teeth.

PLATE 2.—*Euglandina.*

FIGS. 12-13.—*E.* (*Varicoglandina*) *stigmatica* (Sh.), Sumidero, Mexico: 12. Dissected genitalia (ovotestis missing). 13. Radula; central with both 1st (left one abnormal), 6th, 13th, and 14th teeth; also (T) line of half row with blocks of 6 teeth marked.

FIGS. 14-15.—*E.* (*Guillarmodia*) *pupa* H.B.B., Atoyac, Mexico: 14. Dissected genitalia (ovotestis and part of duct omitted). 15. Radula; central with inner 5th and 13th teeth.

FIG. 16.—*E.* (*Proameria*) *saxatilis* H.B.B., Necaxa, Mexico: Dissected genitalia (ovotestis missing).

FIGS. 17-18.—*E.* (*Cosmomenus*) *cumingii* (Beck), La Fria, Venezuela: 17. Dissected genitalia (ovotestis and most of duct missing; atrium everted and penial base formerly so). 18. Radula; central with both 1st and 11th teeth.

FIGS. 19-20.—*E.* (*C.*) *cylindracea* (Phillips), Progreso, Yucatan: 19. Radula; central and 1st tooth. 20. Dissected genitalia (ovotestis omitted and female organs still slender).

FIGS. 21-22.—*E.* (*Singleya*) *singleyana* (W. G. Binney), New Braunfels, Texas. 21. Dissected genitalia (ovotestis omitted). 22. Radula; central with inner 2nd and 10th teeth; also (T) line of half row with blocks of 7 teeth marked.

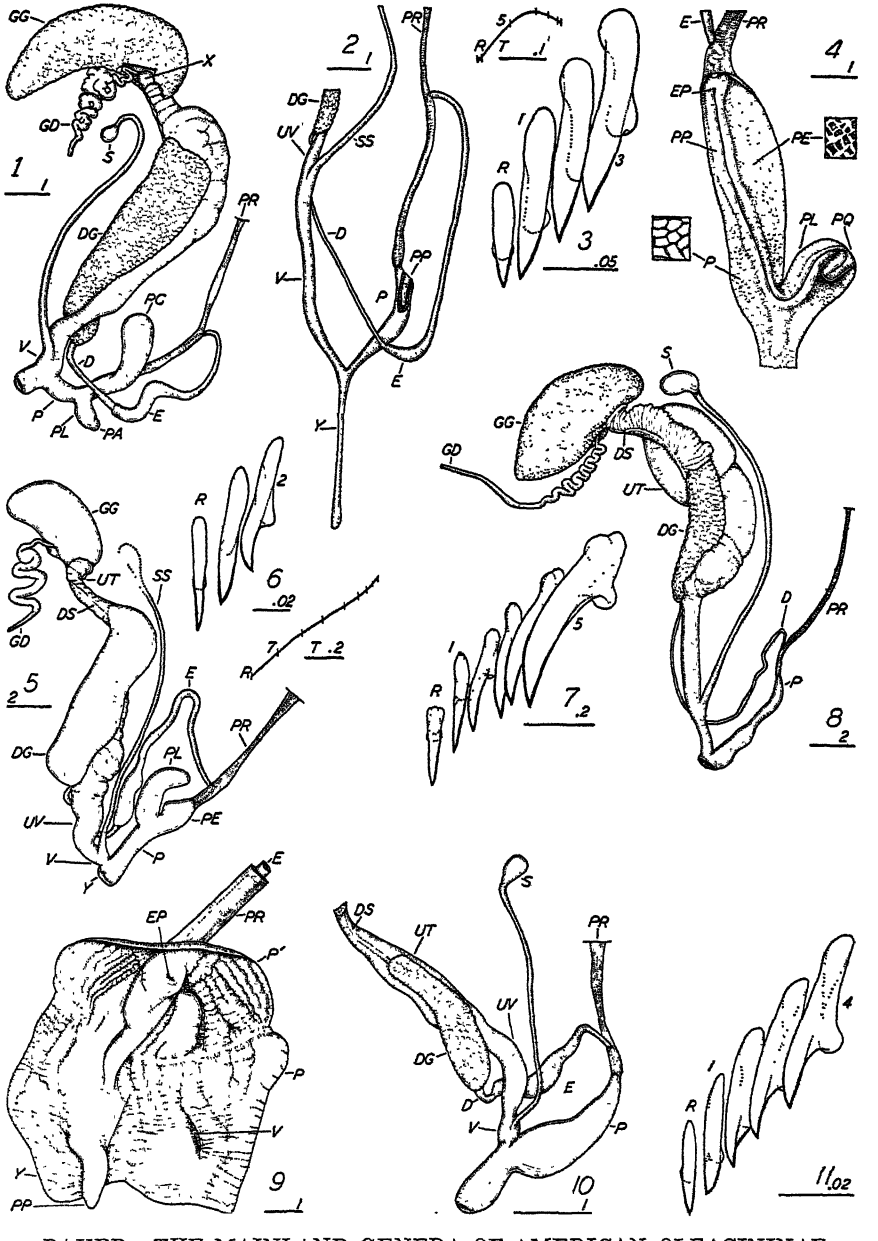
FIG. 23.—*E.* (*S.*) *decussata* (Desh.), Cuatotolapam, Mexico: Radula; central with both 1st and 5th teeth.

PLATE 3.—*Euglandina* and *Pittieria.*

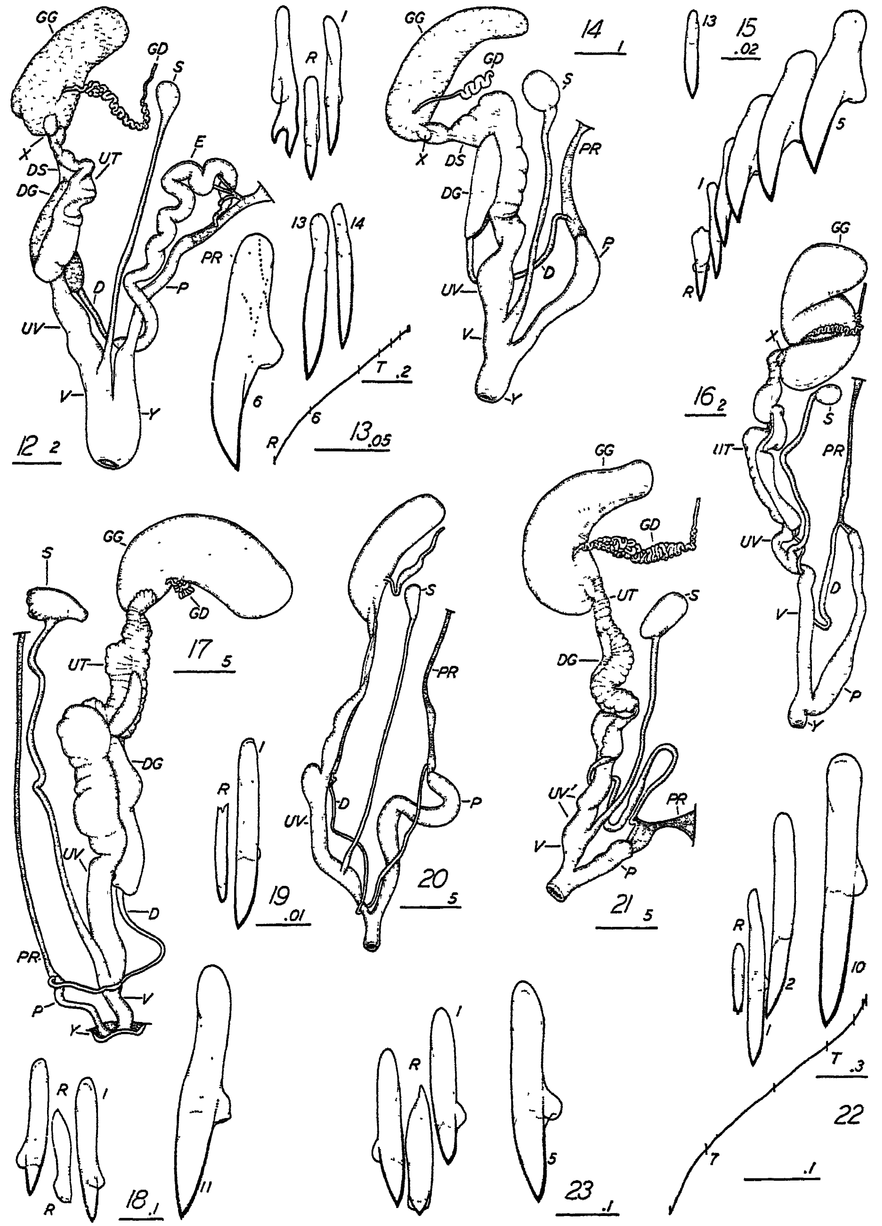
FIG. 24.—*Euglandina* (s.s.) *vanuxemensis* (Lea), Pirámides, Mexico: Dissected genitalia (ovotestis omitted).

FIGS. 25-28.—*P.* (*Shuttleworthia*) *arborea* H.B.B., Necaxa, Mexico: 25. Dissected genitalia (ovotestis omitted). 26. Penis, vagina, and atrium, cut open lengthwise and spread out. 27. Radula; central with both 1st, 7th, and 21st teeth; also (T) line of half row with blocks of 7 teeth marked. 28. Outer lung wall; parietal angle left intact so right anterior corner of lung under parietal mantle-lappet; left posterior corner of lung stretched in direction of arrows (compare lengths of 2 limbs of cut).

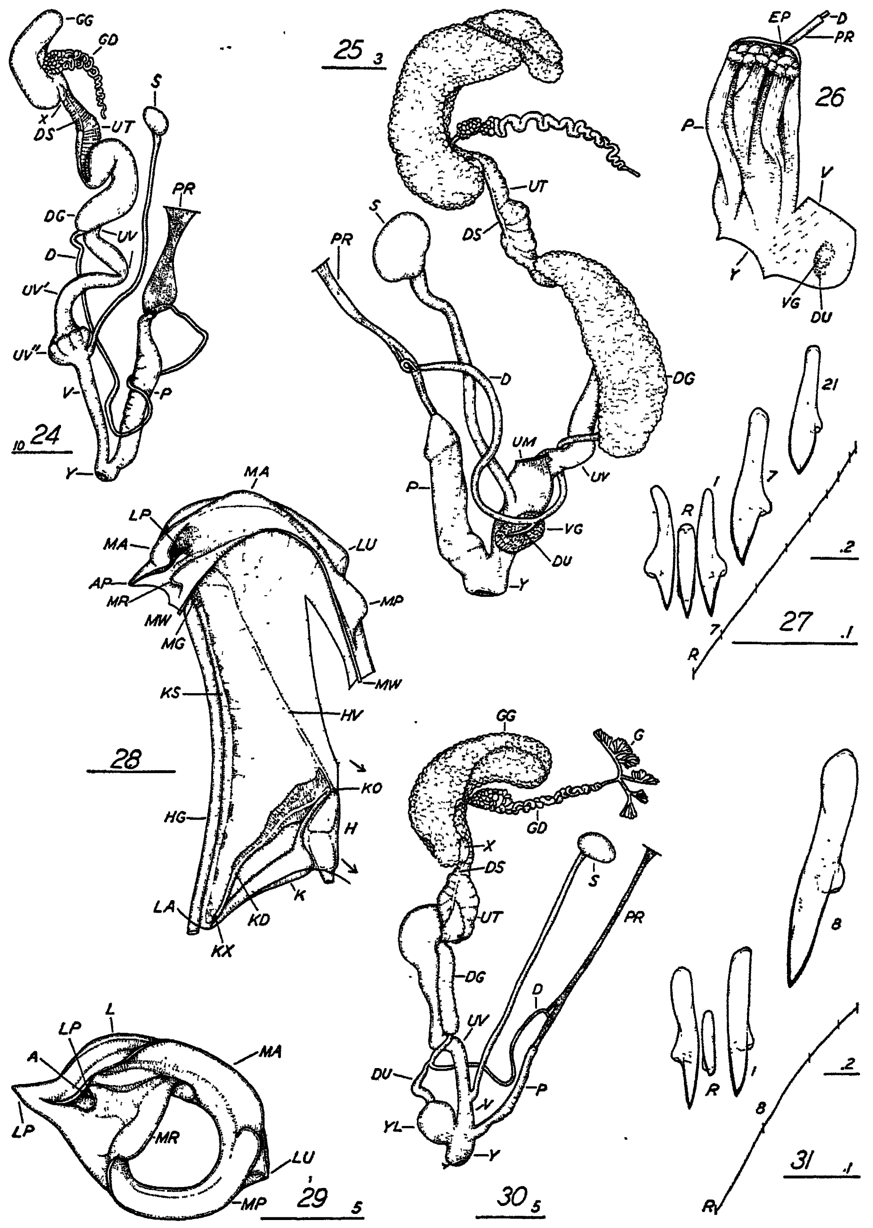
FIGS. 29-31.—*P.* (*Laeviglandina*) *chiriquiensis* (DaCosta), Volcán de Chiriquí, Panamá: 29. Mantle-collar, with palatal lappets, except parietal end of angulopalatal, reflected outward, and parietal one mainly reflected inward. 30. Dissected genitalia. 31. Radula; central with both 1st and 8th teeth; also (T) line of half row with blocks of 8 teeth marked.



BAKER: THE MAINLAND GENERA OF AMERICAN OLEACININAE



BAKER: THE MAINLAND GENERA OF AMERICAN OLEACININAE



BAKER: THE MAINLAND GENERA OF AMERICAN OLEACININAE

FAUNA OF THE RARITAN FORMATION OF NEW JERSEY

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INTRODUCTION

Although an extensive flora has been described from the Raritan formation of New Jersey, its known fauna has been exceedingly meager, only some eight species, probably of brackish water affinities, having been described. The discovery of a new fossiliferous horizon within the Raritan formation containing 22 species not previously reported from that formation has made it necessary to review the earlier work as well as to describe, or record, the additional material.

ACKNOWLEDGMENTS

The present study is part of a cooperative program arranged between the Academy of Natural Sciences of Philadelphia, and two divisions of the New Jersey Department of Conservation and Development—the New Jersey State Museum and the Division of Geology and Topography. It has benefited by the keen interest of Meredith E. Johnson, New Jersey State Geologist and Dr. B. F. Howell, Curator of Geology and Paleontology at the Academy.

The writer is indebted to Mr. Roger Baker, of the United States Geological Survey, who, while making a study of the groundwaters of Middlesex County, N. J., originally discovered the new fauna and called the attention of Mr. Johnson and the writer to it.

He is indebted to Dr. L. W. Stephenson and Dr. J. B. Reeside, Jr., of the United States Geological Survey, for suggestions regarding the relationship of the Raritan fauna. Several conferences in Washington with these gentlemen proved most stimulating.

Thanks should also be given to Miss Anne Harbison, of the Academy of Natural Sciences of Philadelphia, whose assistance has been of considerable help in the present study. It was largely because of her interest in paleontological research that this study became possible.

The manuscript was completed at the North Carolina State Museum in Raleigh, N. C., and the photographs were prepared in their laboratory by Mr. Allen L. Midyette, Jr.

DESCRIPTION OF THE RARITAN FORMATION

The Raritan formation consists chiefly of light-colored sand and clay, some of the clay being highly refractory. The thickness ranges from between 150 and 300 feet at the outcrop, to something over 500 feet as shown in wells in the southeastern part of New Jersey. It outcrops, or occurs at shallow depths, along a line between Trenton and Staten Island. Near Princeton Junction and to the northeast it lies on bevelled Triassic rocks, while near Trenton and farther southwest it lies on rocks of Palaeozoic or pre-Palaeozoic age. It dips 40 to 60 feet per mile to the southeast, the basal beds having the steeper inclination.[1] The formation is best exposed in the Raritan valley where it has been dug extensively for commercial purposes. Seven subdivisions have been recognized in this area.[2]

South of Trenton the Raritan has been struck in numerous wells at increasing depths to the southeast, where it is frequently overlain by later Cretaceous and Tertiary formations.

Flora of the Raritan Formation

The flora is very extensive and consists of between 160 and 170 species. Several lists of this flora have been published in addition to two complete monographs. The earlier monograph, by Newberry,[3] was published posthumously and was edited by Professor Arthur Hollick. This report also included the flora of the Magothy formation since at this time the two formations were regarded as a unit.

The later report by Berry [4] is more exhaustive and is restricted to the Raritan formation in its present sense. Berry suggested a basal Upper Cretaceous age for the Raritan flora and correlated it with the Cenomanian of Europe.

PREVIOUS WORK ON THE RARITAN FAUNA

Conrad [5] described the following two species from "Washington, Middlesex County, N. J.", an old name for South River.

Astarte veta Conrad *Astarte annosa* Conrad

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[1] Kummel, H. B., The Geology of New Jersey, Bull. 50, N. J. Dept. Consv. & Dev., p. 115, 1940 (1941).

[2] Geol. Surv. N. J., Final Rept., vol. 6, pp. 168-196, 1904.

[3] Newberry, J. S., The Flora of the Amboy Clays, Mon. U. S. Geol. Surv., vol. 26, 1895 (1896).

[4] Berry, E. W., The Flora of the Raritan Formation, Geol. Surv. N. J., Bull. 3, 1911.

[5] Conrad, T. A., Amer. Jour. Conch., vol. 4, p. 279, pl. 20, fig. 4, 1869.

Whitfield[6] added three species in his monograph on the New Jersey Cretaceous:

Corbicula ? emacerata Whitfield
Gnathodon ? tenuidens Whitfield
Ambonicardia cookii Whitfield

Weller[7] reviewed the earlier work on the fauna and added the following records:

Corbula manleyi Weller
Cymbophora lintea (Conrad)?
Turritella cf. *jerseyensis* Weller

Until the present time these eight species were all that was known from the Raritan formation. All were from the lower portion of the formation and, according to Weller "although the generic relations of all the species are more or less in doubt, all (first five) seem to be of brackish water types, just such forms as might be expected to occur in beds having the estuarine origin of these Raritan clays and sands." On the other hand, species of *Corbula* live in both brackish and marine water, while the *Turritella* and *Cymbophora* indicate marine conditions.

Correlation of the Raritan Formation

On the basis of its plant remains, Berry[8] correlated the Raritan with the lower Cenomanian of Europe which is basal Upper Cretaceous.

Originally, the Raritan and the next overlying New Jersey formation (Magothy) were regarded as the same, but later work demonstrated a disconformity between the two formations. Furthermore, the Magothy fauna is quite different from that of the Raritan and clearly indicates marine conditions. The flora of the Magothy is regarded as being younger than that of the Raritan.

As indicated elsewhere, the Raritan usually lies on Triassic or earlier rocks, and there are no Lower Cretaceous deposits known to outcrop in New Jersey.

In Delaware and Maryland, deposits of Lower Cretaceous age (Patapsco and Patuxent) are known to occur beneath the Raritan and outcrop at numerous places. It is probable that these Lower Cretaceous deposits originally extended into New Jersey and have since been eroded. Possibly some Lower Cretaceous beds have been struck in deep wells in the vicinity of Salem and elsewhere along the Delaware River, but they have not been differentiated from the Raritan.[9]

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6 Whitfield, R. P., Geol. Surv. N. J., Paleontology, vol. 1, 1886.

7 Weller, Stuart, Geol. Surv. N. J., Paleontology, vol. 4, 1907.

8 Berry, E. W., 1911, op. cit., p. 2.

9 Kummel, H. B., 1940, op. cit., p. 115.

Correlation Farther South

It will be impossible to review all the work on the southern Cretaceous formations possibly equivalent to the Raritan. Suffice it to say that paleobotanical and stratigraphic evidence suggests a correlation with the Tuscaloosa formation, originally described from Alabama,[10] and known to occur also in Mississippi, Georgia, South and North Carolina.[11] In North Carolina, the formation mapped as Patuxent of Lower Cretaceous age[12] is now regarded as at least partly Tuscaloosa and thus equivalent to the Raritan. The true Patuxent formation in Maryland is of Lower Cretaceous age.

Except for a few obscure casts of *Ostrea* and *Modiolus* sp. (?) in Alabama, no brackish or marine fossils have been reported from the Tuscaloosa formation. Fossil plants are abundant in South Carolina, Alabama, and Mississippi.

The Woodbine formation of Texas is also considered to be approximately basal Upper Cretaceous and is correlated with the Cenomanian of Europe.[13] The close relationship of the Raritan with the Woodbine will be pointed out under the discussion of the species in a later section of this report.

Correlations Farther North

Stephenson[14] pointed out that material dredged from Banquereau, off Nova Scotia, probably represents a northward extension of the Raritan formation of New Jersey. This correlation will be further discussed in a later section.

INVERTEBRATE FOSSIL LOCALITIES IN THE RARITAN FORMATION

Previously Reported

1. *Washington, N. J.* Conrad's locality was given as " ash-colored clay near Washington, Middlesex County, N. J." Washington is a former name for South River.
2. *Sayreville, N. J.* Sayre and Fisher Pits. Fossils collected by Whitfield and other early collectors. Exact horizon not given.
3. *Sayreville, N. J.* Furman's Clay Pits. Type locality of *Corbula manleyi* as reported by Weller.
4. *Woodbridge, N. J.* R. N. and H. Valentine Pits (Whitfield).
5. *East Brunswick, N. J.* After Whitfield—no data given.

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[10] Smith, A. E. and L. C. Johnson, U. S. Geol. Surv., Bull. 43, pp. 98-116, 1887.

[11] Cooke, C. W., U. S. Geol. Surv., Bull. 867, 1936.

[12] Stephenson, L. W., et al., North Carolina Geol. and Econ. Surv., vol. 3, 1912.

[13] Adkins, W. S., Geol. of Texas, vol. 1, Univ. of Texas, Bull. 3232, pp. 400-422, 1932.

[14] Stephenson, L. W., Bull. Geol. Soc. Amer., vol. 47, pp. 367-410, 1936.

New Localities

6. *Sayreville, N. J.* Sayre and Fisher Pits. Many poorly preserved fossils were found in impure siderite nodules in the upper portion of the Woodbridge member of the Raritan formation. The locality was noted by Mr. Roger Baker who called the attention of Mr. Meredith E. Johnson, State Geologist of New Jersey, and the writer to it.

7. *Sayreville, N. J.* A few additional fossils were found in the pits of the New Jersey Clay Products Company.

8. *Fort Dix, N. J.* Unidentified pelecypods were taken from a depth of 767 feet in a well at Fort Dix, Burlington County, N. J.

9. *Clementon, N. J.* Unidentified shell fragments together with lignite and amber were found in a well at Clementon, Camden County, N. J., between the depths of 631½ and 633 feet. According to Meredith E. Johnson, State Geologist, this is most probably in the Raritan formation.

Description of the Fauna

Note.—The fossils from the Raritan formation are, almost without exception, very poorly preserved. For this reason it might be better to leave them undescribed, or merely to refer them to what seems to be the nearest genus. However, an attempt has been made to write descriptions for most of them, even though it is realized that such descriptions are at the best inadequate and incomplete. This is done, because by giving specific names to the fossils it is easier to discuss the probable relationship between the Raritan fauna and those most closely related. A specific name gives a "handle" whereby the fossils may be discussed and compared with other species. Undoubtedly if additional and better material is obtained from the Raritan formation, more complete descriptions can be written. It is also probable that certain of the generic determinations will be changed by a study of additional specimens.

The symbol * will be placed after the word Sayreville in the following discussion to indicate that the species in question have been collected in the course of the recent field work.

Unless otherwise indicated, the various species are known only from the Raritan formation of New Jersey. The distribution and relationship of the fauna is summarized in Table 1.

PELECYPODA

Astarte veta Conrad — Plate 4, fig. 9; plate 5, fig. 4.

Astarte veta Conrad, Amer. Jour. Conch., vol. 4, p. 279, pl. 20, fig. 4, 1869; Whitfield, Geol. Surv. N. J., Pal., vol. 1, p. 23, pl. 2, fig. 1, 1886; Weller, Geol. Surv. N. J., Pal., vol. 4, p. 549, pl. 60, fig. 3, 1907.

Known only from a single specimen described by Conrad from Washington (= South River). According to Conrad, the shell is close to *A.*

triasina.[15] Whitfield did not have the type at hand, but suggested that Conrad's species might be a young individual of *Gnathodon ? tenuidens* Whitfield, but "the apparent want of gibbosity would not agree." The type has been located in the Academy of Natural Sciences, but no further suggestions can be offered regarding the relationship of the species. It does superficially resemble the German *A. triasina* Roemer, although even its position within the genus *Astarte* is open to question because the hinge is not visible in the New Jersey shell.

RARITAN.—"Washington" (now called South River).

Collections.—A.N.S.P. (Type) 14360.

Astarte ? annosa Conrad Plate 4, fig. 8.

Astarte annosa Conrad, Amer. Jour. Conch., vol. 4, p. 279, pl. 20, fig. 4, 1869; idem., vol. 5, p. 227, 1870.

Corbicula ? annosa Whitfield (in part), Geol. Surv. N. J., Pal., vol. 1, p. 26, 1886; Weller (in part), Geol. Surv. N. J., Pal., vol. 4, p. 563, pl. 62, figs. 1-3, 1907.

Conrad's type has apparently been lost. Whitfield referred two specimens to this species and suggested that it should be placed in the genus *Corbicula.* However, a careful comparison of these specimens with Conrad's description and figure suggests that Whitfield did not have Conrad's species. This opinion was concurred in by Dr. Stephenson, who kindly examined Whitfield's material. It therefore seems desirable to retain the name *Astarte ? annosa* for Conrad's species, which it is hoped will eventually be located. Whitfield's two specimens are given the new name of *Corbicula ? whitfieldi.*

RARITAN.—"Washington" (now called South River).

Collections.— ? (Type lost).

Corbicula ? whitfieldi new name Plate 5, figs. 2, 10.

Corbicula annosa (Conrad), Whitfield, Geol. Surv. N. J., Pal., vol. 1, p. 26, pl. 2, figs. 2-4, 1886 (not *Astarte annosa* Conrad, 1869); Weller, Geol. Surv. N. J., Pal., vol. 4, p. 563, pl. 62, figs. 1-3, 1907 (not of Conrad).

This is the species designated to take care of the specimens erroneously referred by Whitfield to *Astarte annosa* Conrad. Little can be added to the description given by Whitfield, although the position of the species in the genus *Corbicula* is open to question.

RARITAN.—Sayreville, Woodbridge.

Collections.—N.J.S.M. (Type) 7792, 8829.

Corbicula ? emacerata Whitfield Plate 5, fig. 3.

Corbicula ? emacerata Whitfield, Geol. Surv. N. J., Pal., vol. 1, p. 26, pl. 2, figs. 5, 6, 1886; Weller, Geol. Surv. N. J., Pal., vol. 4, p. 564, pl. 62, figs. 4, 5, 1907.

Known only from a few specimens obtained by early collectors. The position of the species in the genus *Corbicula* is open to serious question,

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[15] Roemer, Ferd., Ueber einige neue Versteinerungen aus dem Muschelkalke von Willebadessen, Paleontolographica Naturgeschichte der Vorwelt, vol. 1, p. 312, pl. 36, figs. 1-6, Cassel, 1851.

but in view of the poor preservation it is impossible to determine the correct genus.

RARITAN.—Woodbridge.

Collections.—N.J.S.M. (Type) 7791; A.N.S.P. 15668.

Ambonicardia cookii Whitfield Plate 4, fig. 1.

Ambonicardia cookii Whitfield, Geol. Surv. N. J., Pal., vol. 1, p. 25, pl. 2, figs. 11-14, 1886; Weller, Geol. Surv. N. J., Pal., vol. 4, p. 548, pl. 60, figs. 1, 2, 1907.

Whitfield based his genus *Ambonicardia* on some large internal casts of this species. Superficially they resemble a *Unio* but the position of the muscular impression and the lack of lateral hinge teeth precludes its reference to that genus. A number of specimens have been found, but in none are the features of the external shell preserved. Not represented in recent collections.

RARITAN.—Sayreville, Woodbridge, East Brunswick.

Collections.—N.J.S.M. (Type) 7790; A.N.S.P. 15666, 15667.

Rangia ? tenuidens (Whitfield) Plate 4, fig. 2; plate 5, fig. 1.

Gnathodon ? tenuidens Whitfield, Geol. Surv. N. J., Pal., vol. 1, p. 27, pl. 2, figs. 7-10, 1886.

Rangia ? tenuidens Weller, Geol. Surv. N. J., Pal., vol. 4, p. 635, pl. 73, figs. 6-8, 1907.

Described from casts and consequently the generic determination is questioned. Fairly common among both old and new collections from Sayreville, N. J. Specimens recently obtained bear less resemblance to the genus *Rangia*, but with the lack of sculpture and hinge, it is impossible to determine the correct genus.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. (Type) 8839, 10462; A.N.S.P. 15657.

Corbula manleyi Weller Plate 5, figs. 6-9.

Corbula manleyi Weller, Geol. Surv. N. J., Pal., vol. 4, p. 636, pl. 62, figs. 1-8, 1907.

Collected by Mr. John M. Manley from the base of the Raritan formation at Furman's Pits, Sayreville, N. J. This is, according to Weller, a lower horizon than that from which Whitfield's specimens were obtained. According to Weller, the species is unrelated to any other species of *Corbula* in the New Jersey Cretaceous.

RARITAN.—Sayreville.

Collections.—Walker Museum, University of Chicago (Type) 10833.

Corbula manleyi var. **duplex** new variety Plate 6, fig. 6.

Similar in size and shape to *C. manleyi* Weller, but characterized by its more irregular striations, many of which appear to consist of double bands separated by an interspatial groove. Length 10 mm.; width 15 mm.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. 10537; A.N.S.P. (squeeze of type) 15661.

Corbula greywaczi new species Plate 4, fig. 10

Shell small, trigonal in outline, moderately inflated. A narrow, sharply defined carina-ridge extends from the beak to the posterior extremity; beak prominent, incurved, about $\frac{2}{5}$ the length of the shell from the anterior extremity; posterior part of the shell more pointed than the anterior. Shell surface covered with even concentric ridges. Length 5.0 mm.; width 7.5 mm.

The shell is smaller than *C. manleyi* Weller, less elongate with a less prominent ridge and with more even concentric ridges. It is closer to *C. latona* Stephenson from Banquereau, Nova Scotia, but has coarser ridges and a slightly more prominent carina-ridge.

Named in honor of Mrs. Kathryn B. Greywacz, Curator of the New Jersey State Museum.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. (Type) 10543; A.N.S.P. (squeeze of type) 15662.

Cardium (Granocardium) sayri new species Plate 5, fig. 11.

Shell moderately small; somewhat convex, subovate, about twice as long as wide. Beak prominent, slightly incurved. Hinge not shown on type specimen. The surface is ornamented with about 35 smooth ribs with rows of spines in the interspaces. The tops of the ribs are almost flat, and there is an indication of a fine line along the center of each rib. The ribs are slightly larger and more triangular in cross section toward both the anterior and posterior margin of the shell. Length 17.0 mm.; width 13.0 mm.

This species differs from other species of *Granocardium* although it is fairly close to *Cardium* (*Granocardium*) *dumosum* Conrad. It is, however, more ovoid and somewhat larger. It is also related to *Cardium* (*Granocardium*) *atlanticum* Stephenson from Georges Bank.

The position of the subgenus *Granocardium* is fully discussed in a recent monograph by Stephenson.[16]

RARITAN.—Sayreville*.

Collections.—N.J.S.M. (Type) 10442.

Cardium (Granocardium) raritanensis new species Plate 5, fig. 14.

A portion of the beak of a species of *Granocardium* much larger than *Cardium* (*G.*) *sayri* was obtained from Sayreville. Although incomplete, it is herewith described as new.

Shell moderately large, probably sub-quadrate in outline. Beak prominently curved. Conspicuous fine ribs with rows of spines in the interspaces. The ribs are more numerous than in *C. sayri*, also the beak is much more curved and the outline of the shell is more convex. The species resembles *Cardium* (*Granocardium*) *tenuistriatum* Whitfield from the New Jersey Cretaceous but appears to have finer striations. Length 34.5 mm.

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[16] Stephenson, L. W., The Larger Invertebrate Fossils of the Navarro Group of Texas, Univ. of Texas, Bull. 4101, p. 196, 1941.

A more adequate description of the species and a discussion of its relationship must await better material.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. (Type) 10538.

Mytilus ? planus new species Plate 4, fig. 5.

Shell narrow, beak pointed, surface smooth. Has outward appearance of a *Mytilus*, but the exact relationship can not be determined because of the poor state of preservation. Length 23.0 mm.; greatest width 15.0 mm.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. (Type) 10447.

Pinna sp. Plate 5, fig. 5.

One fragment is definitely related to this genus, but specific identification is impossible.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. 10574.

Exogyra sp. a Plate 5, fig. 13.

Shell moderately smooth, beak curved, faint traces of striations. Should be compared with *Exogyra* sp. described by Stephenson from Banquereau.[17] Because of the poor preservation and the fact that the specimens might be young of any one of several species of *Exogyra*, it does not seem desirable to give a specific name. Several valves were found; the two whose measurements are given below are the best.

Length 18.0 mm.; width 13.0 mm.

Length 14.0 mm.; width 11.0 mm.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. (Type) 10444; A.N.S.P. 15654.

Cymbophora sp. (?)

Cymbophora lintea (Conrad), Weller, Geol. Surv. N. J., Pal., vol. 4, pp. 29, 632, pl. 80, 1907 (probably not of Conrad 1860).

Some impressions of a small pelecypod on a slab of sandstone from the Sayre and Fisher Pits were questionably referred to *C. lintea* (Conrad) by Weller. The slab also contained numerous specimens of *Turritella* sp. *C. lintea* was recorded by Weller as common in the Cliffwood formation of New Jersey (= Magothy) and also occurring in the higher Cretaceous formations of the State. Stephenson[18] referred Weller's figured specimens from the Cliffwood to *C. trigonalis* Stephenson which he described from the Black Creek formation of North Carolina. The true *C. lintea* (Conrad) is known

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[17] Stephenson, L. W., Upper Cretaceous Fossils from Georges Bank (including species from Banquereau, Nova Scotia), Bull. Geol. Soc. Amer., vol. 47, p. 390, pl. 4, fig. 1, 1936.

[18] Stephenson, L. W., North Carolina Geol. and Econ. Surv., vol. 5, pp. 336-338, 1923.

from the Cretaceous of Mississippi and Texas. Since the Raritan specimens are merely poorly preserved impressions, it does not seem wise to refer them to any particular species of *Cymbophora*, if indeed the generic determination is correct.

RARITAN.—Sayreville.

Collections.—N.J.S.M. 8819.

Anomia argentaria Morton (?) Plate 5, fig. 12.

Anomia argentaria Morton, Amer. Jour. Sci., vol. 23, p. 293, pl. 5. fig. 10, 1833; Whitfield, Geol. Surv. N. J., Pal., vol. 1, p. 42, pl. 4, figs. 10, 11, 1886; Weller, Geol. Surv. N. J., Pal., vol. 4, p. 496, pl. 44, figs. 11-15, 1907.

Several specimens from Sayre and Fisher Pits are questionably referred to this species, although not all features are preserved on the shells. *A. argentaria* Morton is a widespread Cretaceous species and is known from the Magothy, Merchantville, Marshalltown, Wenonah, Navesink, and Red Bank formations in New Jersey. It is also known from the Cretaceous of Delaware, Maryland, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Tennessee, Arkansas, and Texas. A specimen questionably referred to this species was figured by Stephenson from the Grand Banks. Because of this wide distribution—stratigraphic as well as geographic—it seems likely that the Raritan specimen may be referred to this species. The type is from " New Jersey " and is in the Academy of Natural Sciences.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. 10441, 10477; A.N.S.P. 15655.

Leptosolen ? elongata Weller Plate 4, fig. 7.

Leptosolen ? elongata Weller, Geol. Surv. N. J., Pal., vol. 4, p. 627, pl. 70, figs. 27-28, 1907.

One specimen appears to be identical with Weller's type from the Red Bank formation at Middletown, N. J.

RARITAN.—Sayreville*.

Collection.—N.J.S.M. 10483.

Inoceramus proximus Tuomey Plate 6, fig. 1.

Inoceramus proximus Tuomey, Proc. Acad. Nat. Sci. Phila., vol. 7, p. 171, 1854; Weller, Geol. Surv. N. J., Pal., vol. 4, p. 424, pl. 40, figs. 1-6, pl. 41, fig. 1, 1907.

One large specimen from Sayre and Fisher Pits. The species is also known from the Cliffwood (=Magothy), Merchantville, and Marshalltown formations of New Jersey as well as the Cretaceous of North Carolina (?) and Mississippi.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. 10577.

Aphrodina johnsoni new species Plate 4, fig. 3, 4.

Shell moderately large, subtriangular; conspicuously striated concentrically; type with about 35 striations, closer together near the beak. Valves

convex; beak nearly central, very slightly incurved. Hinge not visible on any specimens. Length 23.0 mm.; width 21.0 mm.

Resembles *A. tippana* (Conrad) in general shape but distinguished by its conspicuous concentric striations. Another related form is *A. regia* Conrad from the Cretaceous of North Carolina, South Carolina, Georgia, Alabama, and Mississippi, but this latter species differs by its much larger size and its lack of uniform concentric striations. The markings on the shell of *A. johnsoni* resemble those of *Meretrix eufaulensis* (Conrad) from Coon Creek, Tennessee, although the curved shape of the margins of the shell suggests a relationship closer to *Aphrodina*.

One individual (N.J.S.M. 10446; pl. 4, fig. 3) may possibly represent a variety, but more probably is merely a crushed individual of the typical species.

Named in honor of Meredith E. Johnson, New Jersey State Geologist.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. (Type) 10454, 10446; A.N.S.P. 15658, 15677.

Plicatula howelli new species Plate 4, fig. 6.

Shell irregular in outline; length greater than width; very slightly convex. Hinge indistinct. Surface ornamented with 12 prominent ribs evenly distributed and about 1.0 mm. apart. The crests of these ribs are covered with spine-like protuberances about 0.5 mm. apart. Between the major ribs can be seen irregular series of small nodules, particularly noticeable near the margin of the shell. Length 14.0 mm.; width 16.0 mm.

The species resembles *P. clarki* Stephenson, from the Black Creek formation of North Carolina, in the presence of the minor ribs between the major ribs, although they are less conspicuous in *P. howelli* than in *P. clarki*. The major spines of *P. howelli* are also less conspicuous than in *P. clarki* and there are no indications of the small tubes described on the ribs of the North Carolina species, although these latter structures may have been destroyed by weathering. The new species also differs from *P. clarki* in that its proportions are relatively much longer in relation to width.

It is apparently not very closely related to any of the three species of *Plicatula* described from the Cretaceous of New Jersey, although it resembles *P. urticosa* (Morton) in the arrangement of the major ribs. The new species is somewhat variable, but for the present all specimens are referred to a single species.

Named in honor of B. F. Howell of the Academy of Natural Sciences.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. (Type) 10475; A.N.S.P. (paratype) 15665.

Martesia cretacea var. **magnatuba** new variety Plate 7, figs. 1, 2.

Similar in general appearance to *M. cretacea* (Gabb) but considerably larger than any heretofore recorded specimen of that species.

The type consists of a large piece of wood completely replaced by limonite with numerous borings made by the clams. None of the original shells are preserved, and it is therefore impossible to give an adequate description.

M. cretacea (Gabb) was originally described from a group of casts of tubes without knowledge of shell characters.[19] The new variety resembles the type of *M. cretacea* in general appearance and preservation, but differs from it in size. The type of *M. cretacea* (A.N.S.P. 15875) measures 2.6 mm. in length and 0.9 mm. in greatest diameter while the type and average specimen of variety *magnatuba* measures 3.0 mm. in length and 1.4 mm. in greatest diameter.

Gabb's locality for *M. cretacea* was merely given as "Raritan Bay, N. J."; however, the type at the Academy is labelled "near Union, Raritan Bay, N. J." This is probably part of the Merchantville formation.

Gabb[20] subsequently described a single individual of a shell (A.N.S.P. 2283) and referred it to the same species; no locality was given other than "New Jersey."

The New Jersey State Museum has specimens of *P. cretacea* from the Merchantville formation (Lenola, N. J.) and the Marshalltown formation (Sweedsboro, N. J.) identified by Weller,[21] and the Academy has specimens from the Merchantville formation at Maple Shade, N. J., and Merchantville, N. J.

In view of the close resemblance between the Raritan specimen and Gabb's original type and also in view of the probable long geological range of the species, it seems wisest merely to give a varietal name to the new form which belongs to a slightly older geological formation than the typical *M. cretacea.*

A relationship was also noted to *M. constricta* (Phillips) from the Lower Cretaceous and basal Upper Cretaceous of England and with *M. prisca* (Sowerby) from the Lower Cretaceous of England.

The large mass of tubes in the limonitized wood was collected by Meredith E. Johnson and is the property of the New Jersey State Museum. A few individual tubes from the same mass are in the collections of the Academy of Natural Sciences.

Raritan.—Sayreville* (New Jersey Clay Products Pits).

Collections.—N.J.S.M. (Type) 10472; A.N.S.P. (paratype) 15872.

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[19] Gabb, William, Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. 4, p. 393, pl. 68, fig 18, 1860.

[20] Gabb, William, Proc. Acad. Nat. Sci. Phila., vol. 13, p. 324, 1861.

[21] Weller, Stuart, Geol. Surv. N. J., Pal., vol. 4, pp. 654-656, 1907.

GASTROPODA

Anchura bakeri new species Plate 6, fig. 2.

Shell of medium size, spire elongate conical; whorls about six (estimated); very slightly convex; suture slightly impressed. Top portion of type not preserved. Prominent lateral ribs on each whorl, much more conspicuous on all except penultimate. Because of the incomplete preservation of the type, it is impossible to estimate the number of ribs. However, they are slightly closer together and apparently more numerous than in *A. pontana* Stephenson. The body whorl is covered with conspicuous spiral ribs separated by interspaces of irregular width. No riblets were observed in the interspaces. The crossing of the spirals and growth ridges produces a semi-cancellated appearance, although this is less conspicuous than in *A. pontana.* Aperture not visible. The outer lip is extended to form a lip-like structure which, unfortunately, is not perfectly preserved. It apparently had much the shape of the outer lip of *A. pontana.* The shell is closely related to *A. pontana* Stephenson from Banquereau, Nova Scotia, but has slightly coarser axial ribs, less cancellate appearance on the body whorl and outer lip and a less prominent suture. Length 39.0 mm.; greatest width (exclusive of outer lip) 16.0 mm.

Named in honor of Roger Baker of the U. S. Geological Survey.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. (Type) 10448.

Anchura raritanensis new species Plate 5, fig. 15.

Shell of medium size, spire elongate conical; eight whorls, moderately convex; suture deeply impressed; protoconch not preserved. Prominent ribs on each whorl, more conspicuous on the penultimate and antepenultimate. Because of the lack of a perfect specimen, it is impossible to determine the number of ribs. On the penultimate whorl they are approximately 2 mm. apart. A fair trace of spiral lines can be seen on the body whorl. The outer lip was apparently greatly expanded to form a wing-like structure, characteristic of the genus. Most of this outer lip has been broken away; however, notches where the lip was attached to the shell can plainly be seen on the left side of the shell. Length 41.0 mm.; maximum diameter (exclusive of outer lip) 16.0 mm.

Unfortunately the poor preservation of the shell prevents a better description.

Unrelated to any species of *Anchura* previously reported from New Jersey. It differs from *A. bakeri* in its much coarser axial ribs and apparently larger outer lip (as indicated by the notches).

RARITAN.—Sayreville*.

Collections.—N.J.S.M. (Type) 10434; A.N.S.P. (paratype) 15676.

Anchura sp.

A squeeze (N.J.S.M. 10450) represents what is probably another species of *Anchura*, but not enough features are preserved to permit description.

It has five whorls, reticulated markings on the body whorl, and faint indications of an expanded outer lip.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. 10450.

Aliofusus ? sayri new species Plate 5, fig. 17.

Shell of medium size, subfusiform, stout. Protoconch broken away. Whorls about four, increasing in size with considerable rapidity. A shoulder is formed by a broadly excavated band below the suture. A narrow collar borders the suture but no nodes can be observed on it. Conspicuous axial ribs, impossible to count because of the imperfect state of the fossil. The axials are most conspicuous near the shoulder and fade out gradually near the base. The entire surface is covered with faint striae. Aperture not observed. Length 19.0 mm.; greatest width 13.0 mm.

Close to *Aliofusus reagani* Stephenson from the Navarro group of Texas, the type species of the genus, but proportionally somewhat stouter.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. (Type) 10439.

Amauropsis cadwaladeri new species Plate 5, fig. 19.

Shell of medium size, smooth, spire elevated; spire about the length of the aperture. Whorls about five, broadly rounded. Suture deeply sulcate. Length 15.5 mm.; width 9.5 mm.

Resembles *Amauropsis* sp. Stephenson[22] from the Navarro group of Texas.

Named in honor of Mr. Charles M. B. Cadwalader, President of the Academy of Natural Sciences.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. (Type) 10463; A.N.S.P. (paratype) 15656.

Avellana pelagana Stephenson Plate 5, fig. 18.

Avellana pelagana Stephenson, Bull. Geol. Soc. Amer., vol. 47, p. 403, pl. 5, figs. 19, 20, 1936.

One external cast is identical with Stephenson's type from Banquereau, Nova Scotia (N.J.S.M. 10540). Another less well preserved specimen is also referred to this species (A.N.S.P. 15678).

RARITAN.—Sayreville*.

Collections.—N.J.S.M. 10540; A.N.S.P. 15678.

Avellana ? raritana new species Plate 5, fig. 16.

Description based upon a rubber squeeze of the only known specimen. Shell of medium size; whorls about three, expanding rapidly. Body whorl rounded with relatively flat top. Ornamented with ten rows of punctate ribs separated from each other by grooves showing faint traces of punctae. Penultimate whorl with four ribs with much less conspicuous punctae;

[22] Stephenson, L. W., Univ. of Texas, Bull. 4101, p. 278, 1941.

grooves between the ribs show only very faint traces of punctae. Apex not preserved. Aperture and columella not shown. Length 12.0 mm.

Because of the incomplete preservation, any generic determination must be given with considerable doubt. The squeeze, however, does show superficial resemblance to *A. pelagana* Stephenson, although it is easily distinguished by its much more conspicuous spines and the more common punctae. It does not appear to be related to *A. costata* (Johnson) or *A. bullata* (Morton) previously listed from the New Jersey Cretaceous.

According to Dr. Stephenson [23], *A. ? raritana* resembles an undescribed species from the Woodbine formation of Texas.

RARITAN.—Sayreville.*

Collections.—N.J.S.M. (Type) 10541; A.N.S.P. (squeeze of type) 15663.

Gyrodes aff. **petrosus** Morton — Plate 6, figs. 4, 5.

One complete and several incomplete specimens are definitely referred to the genus *Gyrodes*. They resemble *G. petrosus* (Morton) in the smooth, unsculptured character of the shell, but are considerably larger than the true *G. petrosus*, and have a more pronounced shoulder.

RARITAN.—Sayreville.*

Collections.—N.J.S.M. 10542; A.N.S.P. 15679.

Turritella bakeri new species — Plate 6, fig. 3.

Shell of medium size; spire high; whorls closely appressed, suture faintly impressed. Each whorl is ornamented with conspicuous spiral ribs, bearing regularly spaced blunt nodes. The interspaces vary in width and bear fine thread-like secondary lines—usually four to six. These secondary lines are of varying intensity, there usually being one or two in each interspace much more conspicuous than the others. Aperture broken in most specimens, but where preserved appears to be broadly subovate.

Length (Type N.J.S.M. 10575) (incomplete) 35.0 mm.

Length (paratype A.N.S.P. 15680) (incomplete) 36.0 mm.

Resembles *T. macneili* Stephenson dredged from Banquereau, Nova Scotia, but has the individual whorls less conspicuous, less prominent sutures, and a smaller number of secondary interspatial lines. It is equally close to *T. thomasina* Stephenson, also from Banquereau. It is also related to some undescribed nodose species of *Turritella* from the Woodbine formation of Texas. According to Dr. Stephenson [24] these nodose species of *Turritella* are not known later than the basal Upper Cretaceous.

This is one of the commonest species in the siderite layer at the Sayre and Fisher Pits, and it often occurs in large slabs. Many of the specimens are badly weathered.

Named in honor of Roger Baker of the United States Geological Survey.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. (Type) 10575; A.N.S.P. (paratype) 15680.

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[23] Personal communication.

[24] Personal communication.

Turritella cf. **jerseyensis** Weller

Turritella sp. Weller, Geol. Surv. N. J., Pal., vol. 4, p. 29, pl. 80, 1907.

Weller referred some specimens of *Turritella* from a slab obtained from Sayre and Fisher Pits questionably to *T. jerseyensis* Weller which he had described from the Cliffwood clay of New Jersey. Material collected more recently resembles the *Turritella* of Weller's slab and can also be referred questionably to *T. jerseyensis*. The absence of the nodes differentiates it readily from *T. bakeri*, the more common species from the recent locality at Sayreville.

RARITAN.—Sayreville*.

Collections.—N.J.S.M. 8819; A.N.S.P. 15681.

Fasciolaria sp. Plate 3, fig. 7.

One poorly preserved unidentified species of *Fasciolaria* was obtained from the Sayre and Fisher Pits at Sayreville, N. J.

Collections.—A.N.S.P. 15801.

DISCUSSION

1. Thirty-two forms of invertebrates have here been listed from the Raritan formation of New Jersey. Of these fifteen are described as new.

2. The fauna clearly indicates that marine conditions prevailed for at least part of Raritan time. The fact that plant remains are common in other phases of the Raritan formation suggests that marine conditions may not have existed for a very long proportion of Raritan time.

3. Although all the marine fossils herein recorded came from the vicinity of the present Raritan embayment, the finding of unidentifiable fossils in the Raritan formation in wells at Fort Dix and Clementon suggests that this embayment may have covered most of southern New Jersey.

4. The Raritan fauna is very different from that of the next overlying Cretaceous formation of New Jersey (Cliffwood clay of the Magothy formation).

5. Because of the abundant plant fossils the Raritan formation has been regarded as basal Upper Cretaceous and correlated with the Cenomanian of Europe.

6. The closest relationship of the Raritan fauna is with material dredged from Banquereau, Nova Scotia, and with a fauna, largely undescribed, from the Woodbine formation of northeastern Texas.

All are regarded as basal Upper Cretaceous.

7. The Tuscaloosa formation, known from North Carolina to Mississippi, is probably also equivalent to the Raritan and there are many similarities in the flora. The only known fauna from the Tuscaloosa consists of some indistinct fossil shells in Alabama which are of no value in correlation studies.

TABLE 1. Distribution of Raritan Fauna of New Jersey

	Sayreville, N. J.								
PELECYPODA	Sayre & Fisher (new)	Sayre & Fisher (old)	N. J. Clay Products	Furman's Pitts	Woodbridge, N. J.	South River, N. J.	Raritan only	Banquereau, N. S.	Woodbine, Texas
Astarte veta Conrad	—	—	—	—	—	×	×	—	—
Astarte ? *annosa* Conrad	—	—	—	—	—	×	×	—	—
Corbicula ? *whitfieldi* new species	—	×	—	—	×	—	×	—	—
Corbicula ? *emacerata* Whitfield	—	—	—	—	×	—	×	—	—
Ambonicardia cookii Whitfield	—	×	—	—	×	—	×	—	—
Rangia ? *tenuidens* Whitfield	×	×	—	—	—	—	×	—	—
Corbula manleyi Weller	—	—	—	×	—	—	×	—	—
Corbula manleyi duplex new var.	×	—	—	—	—	—	×	—	—
Corbula greywaczi new species	×	—	—	—	—	—	×	a	—
Cardium sayri new species	×	—	—	—	—	—	×	—	—
Cardium raritanensis new species	×	—	—	—	—	—	×	—	a
Mytilus ? *planus* new species	×	—	—	—	—	—	×	—	—
Pinna sp.	×	—	—	—	—	—	?	—	—
Exogyra sp. *a*	×	—	—	—	—	—	?	a	—
Cymbophora sp.	—	×	—	—	—	—	?	—	—
Anomia argentaria ? Morton	×	—	×	—	—	—	—	×	—
Leptosolen ? *elongata* Weller	—	—	×	—	—	—	—	—	—
Inoceramus proximus Tuomey	×	—	—	—	—	—	—	—	—
Aphrodina johnsoni new species	×	—	×	—	—	—	×	—	a
Plicatula howelli new species	×	—	×	—	—	—	×	—	—
Martesia cretacea magnatuba new var.	—	—	×	—	—	—	×	—	—
GASTROPODA									
Anchura bakeri new species	×	—	—	—	—	—	×	a	—
Anchura raritanensis new species	×	—	—	—	—	—	×	—	—
Anchura sp.	×	—	—	—	—	—	?	—	—
Aliofusus sayri new species	×	—	—	—	—	—	×	—	a
Amauropsis cadwaladeri new species	×	—	—	—	—	—	×	—	—
Avellana pelagana Stephenson	×	—	—	—	—	—	—	×	—
Avellana ? *raritana* new species	×	—	—	—	—	—	×	—	a
Gyrodes aff. *petrosus* (Morton)	×	—	—	—	—	—	—	—	—
Turritella bakeri new species	×	—	×	—	—	—	×	a	a
Turritella cf. *jerseyensis* Weller	×	×	×	—	—	—	—	—	—
Fasciolaria sp.	×	—	—	—	—	—	?	—	—

× = present a = allied species

EXPLANATION OF PLATES 4 TO 7

All figures natural size unless otherwise indicated

PLATE 4.

FIG. 1.—*Ambonicardia cookii* Whitfield, Sayreville, N. J. N.J.S.M. 7790.
FIG. 2.—*Rangia tenuidens* Whitfield, Sayreville, N. J. N.J.S.M. 10462.
FIG. 3.—*Aphrodina johnsoni* new species, Sayreville, N. J. N.J.S.M. 10446.
FIG. 4.—*Aphrodina johnsoni* new species, (type), Sayreville, N. J. N.J.S.M. 10454.
FIG. 5.—*Mytilus planus* new species, (type), Sayreville, N. J. N.J.S.M. 10447.
FIG. 6.—*Plicatula howelli* new species, (type), Sayreville, N. J. N.J.S.M. 10475.
FIG. 7.—*Leptosolen ? elongata* Weller, Sayreville, N. J. N.J.S.M. 10483.
FIG. 8.—*Astarte ? annosa* Conrad, South River, N. J. (after Conrad).
FIG. 9.—*Astarte veta* Conrad, South River, N. J. (after Conrad).
FIG. 10.—*Corbula greywaczi* new species, (squeeze of type), Sayreville, N. J. N.J.S.M. 10453.

PLATE 5.

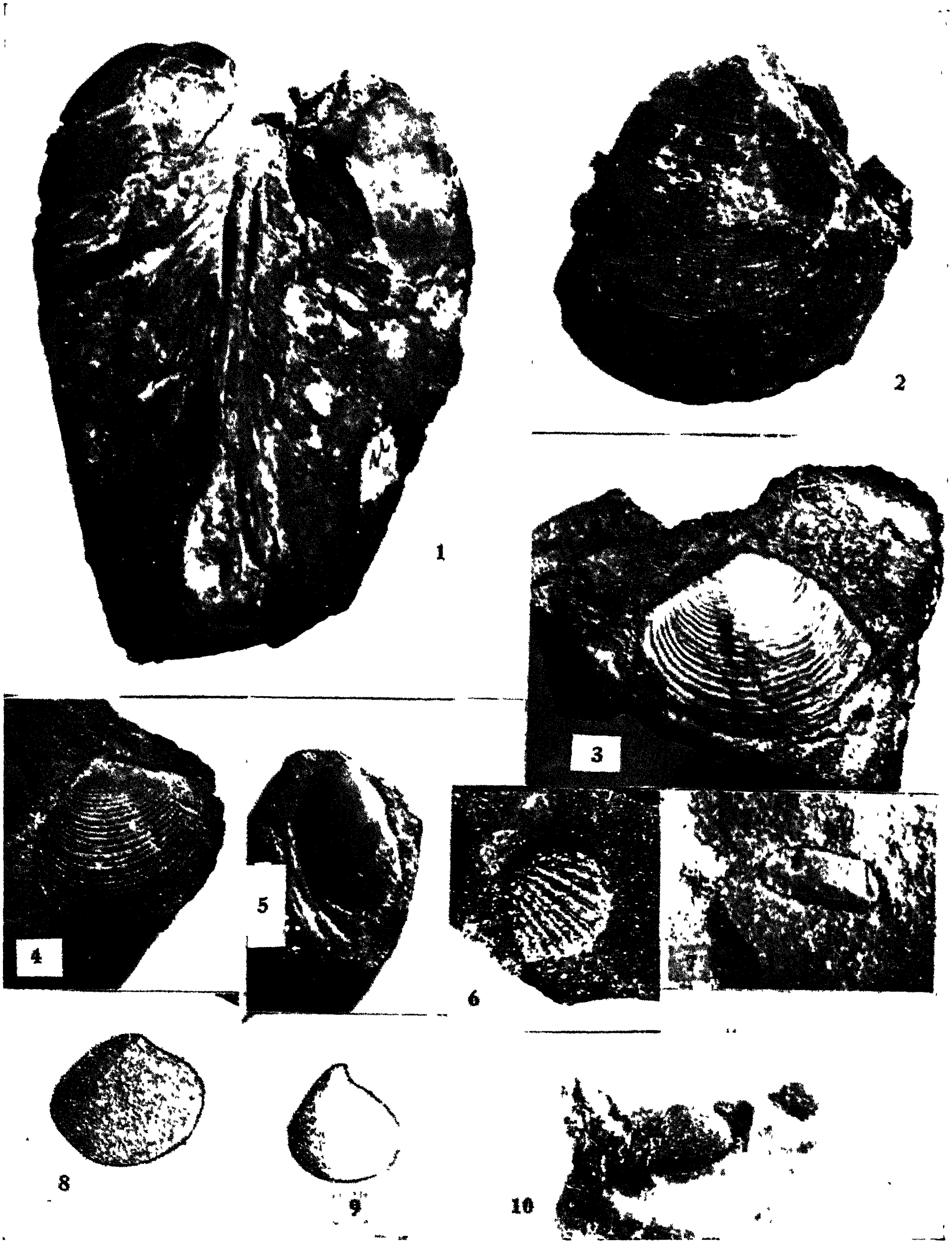
FIG. 1.—*Rangia tenuidens* Whitfield, Sayreville, N. J. N.J.S.M. 7794.
FIG. 2.—*Corbicula ? whitfieldi* new species, (type), Sayreville. N.J.S.M. 7792.
FIG. 3.—*Corbicula ? emacerata* Whitfield, (type), Woodbridge, N. J. N.J.S.M. 7791.
FIG. 4.—*Astarte veta* Conrad, (type), South River, N. J. A.N.S.P. 14360.
FIG. 5.—*Pinna* sp., Sayreville, N. J. N.J.S.M. 10574.
FIGS. 6-9.—*Corbula manleyi* Weller, Sayreville, N. J. Univ. Chicago 10833.
FIG. 10.—*Corbicula ? whitfieldi* new species, Sayreville, N. J. N.J.S.M. 8829.
FIG. 11.—*Cardium sayri* new species, (type), Sayreville, N. J. N.J.S.M. 10442.
FIG. 12.—*Anomia argentaria* Morton, Sayreville, N. J. N.J.S.M. 10441.
FIG. 13.—*Exogyra* sp., Sayreville, N. J. N.J.S.M. 10444.
FIG. 14.—*Cardium raritanensis* new species, (type), Sayreville, N. J. N.J.S.M. 10538.
FIG. 15.—*Anchura raritanensis* new species, (type), Sayreville, N. J. N.J.S.M. 10434.
FIG. 16.—*Avellana ? raritana* new species, (squeeze of type), Sayreville, N. J. N. J. S. M. 15663.
FIG. 17.—*Aliofusus ? sayri* new species, (type), Sayreville, N. J. N.J.S.M. 10439.
FIG. 18.—*Avellana pelagana* Stephenson, Sayreville, N. J. N.J.S.M. 10540.
FIG. 19.—*Amauropsis cadwaladeri* new species, (type), Sayreville, N. J. N.J.S.M. 10463.

PLATE 6.

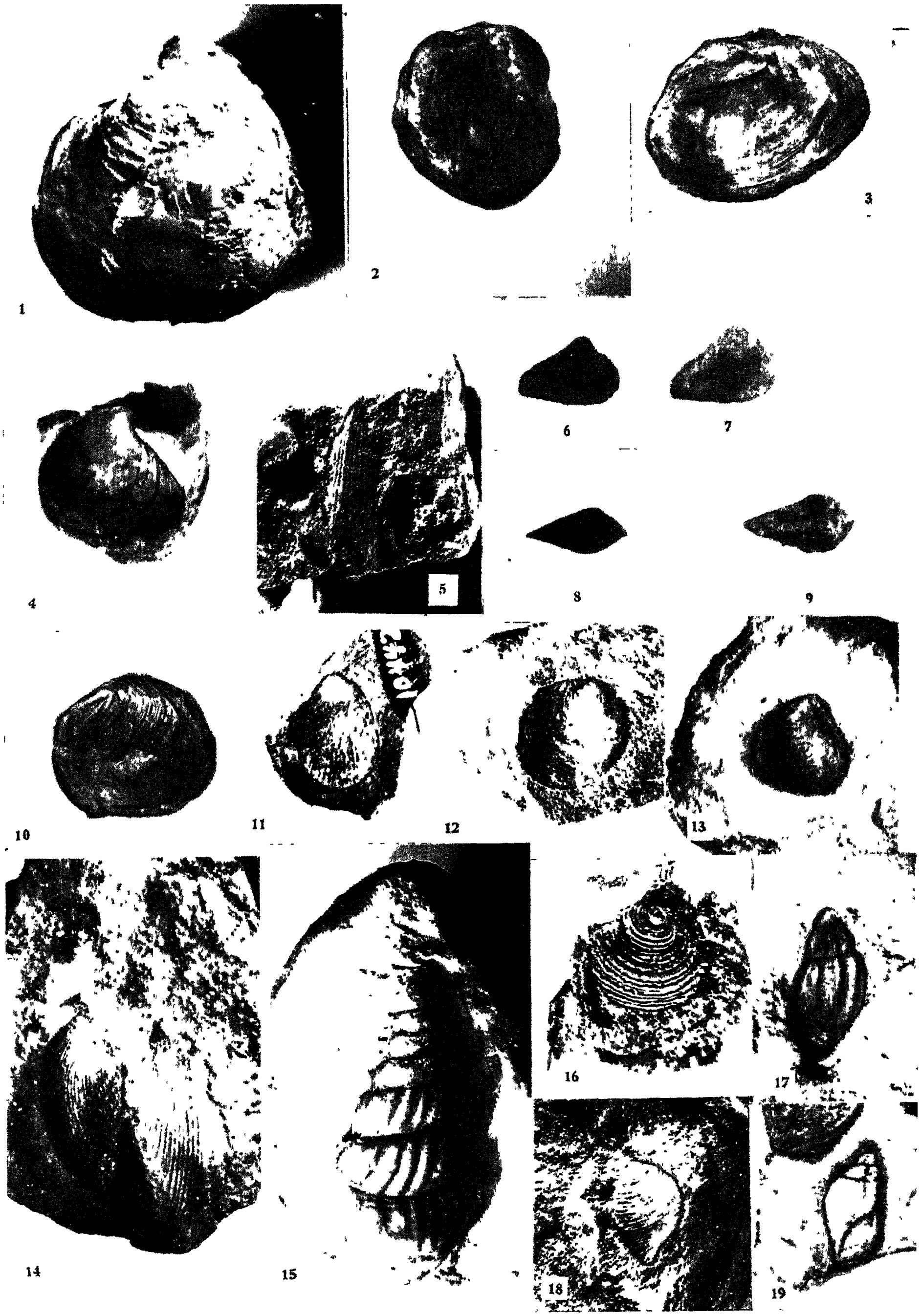
FIG. 1.—*Inoceramus proximus* Tuomey, Sayreville, N. J. N.J.S.M. 10577 (× ½).
FIG. 2.—*Anchura bakeri* new species, (type), Sayreville, N. J. N.J.S.M. 10448.
FIG. 3.—*Turritella bakeri* new species, (type), Sayreville, N. J. N.J.S.M. 10575.
FIGS. 4, 5.—*Gyrodes* aff. *petrosus* Morton, Sayreville, N. J. N.J.S.M. 10542.
FIG. 6.—*Corbula manleyi duplex* new variety, (squeeze of type), Sayreville, N. J. N.J.S.M. 10537.
FIG. 7.—*Fasciolaria* sp., Sayreville, N. J. A.N.S.P. 15801.

PLATE 7.

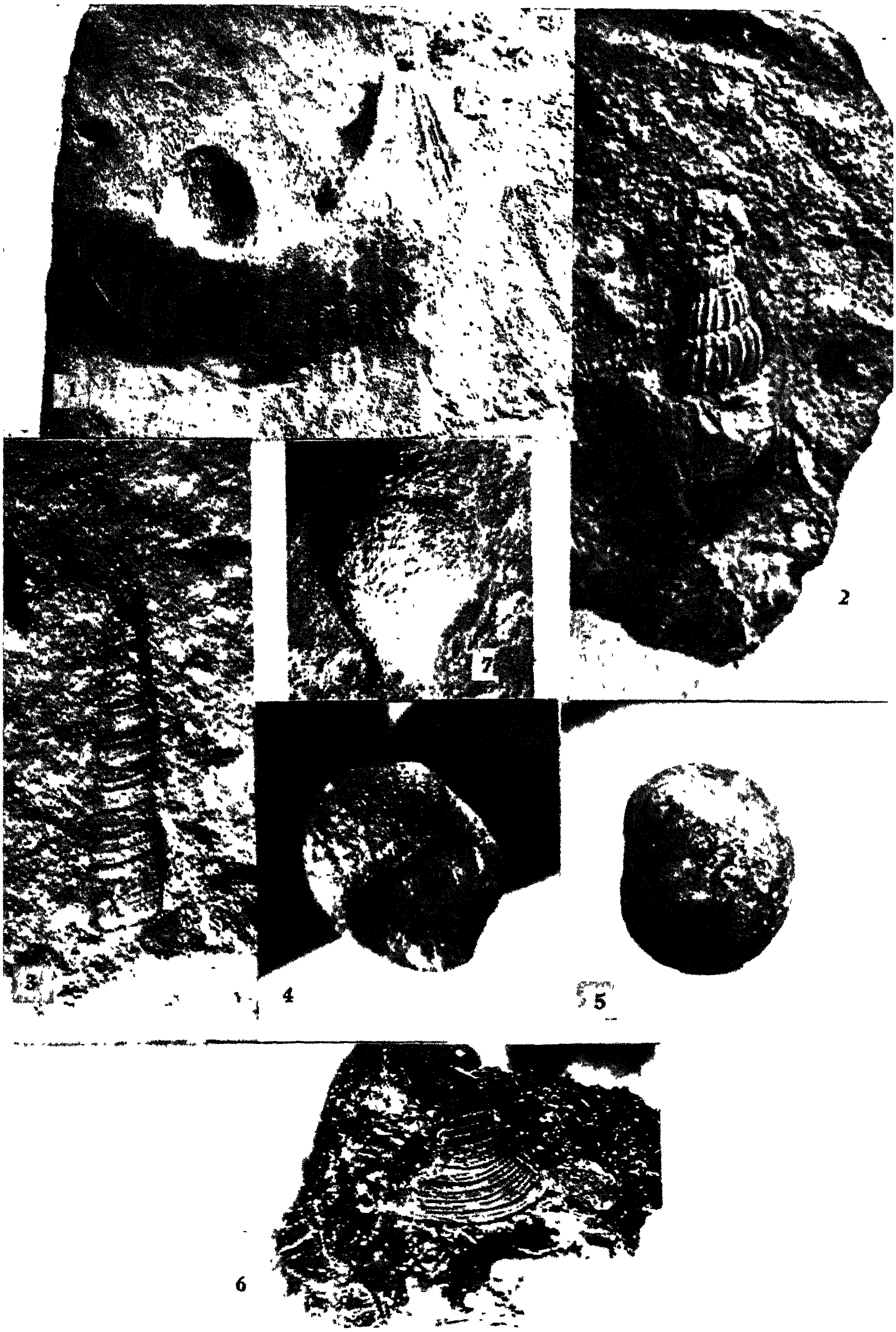
FIGS. 1, 2.—*Martesia cretacea magnatuba* new variety, (type), Sayreville, N. J. N.J.S.M. 10472. (× ½).



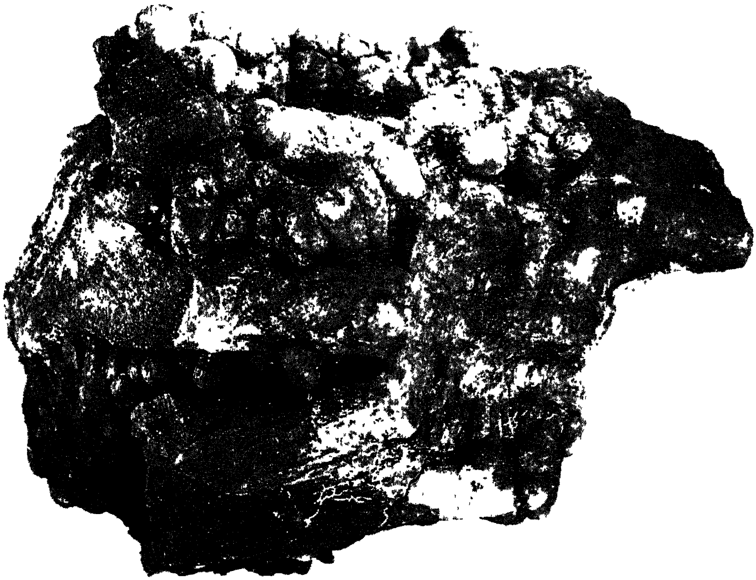
RICHARDS: FAUNA OF THE RARITAN FORMATION OF NEW JERSEY



RICHARDS: FAUNA OF THE RARITAN FORMATION OF NEW JERSEY



RICHARDS: FAUNA OF THE RARITAN FORMATION OF NEW JERSEY



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RICHARDS: FAUNA OF THE RARITAN FORMATION OF NEW JERSEY

THE AUCACRES, A NEW GROUP OF SOUTH AMERICAN LOCUSTS (ORTHOPTERA, ACRIDIDAE, CYRTACANTHACRIDINAE)

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In 1929 my colleague Mr. Morgan Hebard described a striking and unusual genus and species of locusts as *Aucacris eumera,*[1] basing it upon material of both sexes, for which, however, no more specific locality information than " Chile " was available. At that time his comments were that it had " the appearance of a large brachypterous Oedipodid, but examination shows that it belongs instead to the Cyrtacanthacrinae " (more properly Cyrtacanthacridinae). In another paragraph comparison was made with the Lower Californian genus *Litoscirtus* Bruner, which Hebard then considered the nearest ally of *Aucacris.*

In 1937 Dr. B. P. Uvarov, of the British Museum (Natural History), expressed the opinion [2] that the presence of a prosternal tubercle in *Aucacris* could not be considered an infallible index for referring the genus to the Cyrtacanthacridinae (or Catantopinae as he preferred to call it), and that the structure of the head in the genus in question " is definitely of non-Catantopine type, owing to the development of the carinae delimiting a hexagonal fastigium of vertex, and particularly because of the presence of very distinctly defined foveolae of vertex." [3] He also concluded the genus is a member of the Batrachotetriginae, a group which otherwise we now know to be exclusively Old World, and also that this relationship suggests that it is representative of a " highly specialized desert fauna and flora " the origin of which " goes back, perhaps, beyond the Tertiary period."

An additional feature which Dr. Uvarov cited to show the genus *Aucacris* had been erroneously referred to the Cyrtacanthacridinae (or Catantopinae) was " the presence in that genus of a well developed stridulating plate at the antero-inferior angle of the second tergite." This plate he considered to be " characteristic of Batrachotetrigini and most Pamphaginae." Dr. Uvarov in a contemporaneous paper [4] had given the presence of a similar

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[1] Entom. News, XL, p. 253, pl. XV, figs. 1-6. (1929).

[2] Rev. Soc. Entom. Argentina, IX, pp. 4-5.

[3] Apropos the variation which may occur within a single genera group of the Cyrtacanthacridinae in the general fastigial development, and also in the evidence or virtual obliteration of the lateral foveolae, I would refer to my recent studies of the New World Euthymiae (Proc. Acad. Nat. Sci. Phila., XC, pp. 41-102, pls. 1-7, (1938)), and of the Tristirae (Trans. Amer. Entom. Soc., LXVIII, pp. 31-100, pls. III-IX, (1942)).

[4] Pan-Pacific Entomologist, XIII, no. 3. pp. 97-100, (1937).

specialized plate in the genus *Dracotettix* as one of his reasons for referring that Nearctic genus to the Pamphaginae. In discussing the last mentioned paper by Uvarov, I pointed out [5] that similar developments were to be found in numerous genera of several quite different subfamilies of the Acrididae, including at least four clearly unrelated genera of the Cyracanthacridinae, others in the New World Ommexechinae and in both Old and New World genera of the Pyrgomorphinae. It would thus seem that the presence or absence of such plates is of no definite phylogenetic value, as they are developed to various degrees in parallel fashion in numerous phyla.

In 1938 in discussing the Nearctic genus *Dracotettix*,[6] which Uvarov had then quite recently referred to the Pamphaginae, I pointed out that *Litoscirtus*, which Hebard had considered a relative of *Aucacris* when describing the latter, is more nearly related to *Dracotettix* than it is to any other genus at present known. Quite recently my associate Dr. H. Radclyffe Roberts has demonstrated,[7] from the evidence of the internal male genitalia, that my association of *Dracotettix* and *Litoscirtus* was warranted, and he placed both of these genera in his newly constituted subfamily Romaleinae, an entirely New World and largely Neotropical assemblage. In the same paper Dr. Roberts presented the results of a comprehensive study of the morphology of the internal male genitalia of a considerable number of genera of Acrididae. One of the basic conclusions reached was that on the fundamental structure of the parts in question the Pamphaginae and the Batrachotetriginae belong to one larger group (called the Chasmosacci) and the Romaleinae and Cyrtacanthacridinae to another (similarly named the Cryptosacci).

While engaged in this study Dr. Roberts examined the same parts of the male paratype of *Aucacris eumera*, now in the Hebard Collection, at the Academy of Natural Sciences of Philadelphia. His conclusions, then verbally expressed, were that the genus, from that evidence, is a member of the Crytacanthacridinae, and not of either the Batrachotetriginae or the Romaleinae.

In 1913 Prof. Lawrence Bruner described a very unusual new locust genus and species from Ollantaytambo, Peru, taken at an elevation of approximately 9000 feet above sea-level, which he called *Cumainocloidus cordillerae*.[8] Apropos of its relationship his conclusions were that, "while very distinct from all other known forms this insect seems to show affinities with the Ommexichidae (sic) rather than with the Acridiidae or Cyrtacanthacridae, as we may be obliged to write it." Of the two original females

[5] Proc. Acad. Nat. Sci. Phila., XC, p. 127, (1938).
[6] Proc. Acad. Nat. Sci. Phila., XC, pp. 123-132, (1938).
[7] Proc. Acad. Nat. Sci. Phila., XCIII, pp. 219, 239, (1941).
[8] Proc. U. S. Nat. Mus., XLIV, p. 179.

of *Cumainocloidus* the paratypic one is now before me in the Hebard Collection, received in exchange from the United States National Museum, which possesses the single type.

For some years there has been in the Hebard Collection a single male specimen of an undescribed genus from the Province of Neuquen, Argentina, which bears a marked resemblance to the North American desert romaleid *Tytthotyle*, with approximately the same degree of development of the alar organs, a similarly angulate produced caudal margin of the pronotal disk, similar relatively large eyes (in the male sex) and the same mottled, obliterative type of color pattern. A more detailed comparison of the structure of this non-descript, however, shows that these similarities are entirely superficial, and instead, while in quite a few features there is marked difference, in a greater number of more fundamental value this undescribed genus is nearer Hebard's *Aucacris* than it is to any other which has been recognized. Dr. Roberts most kindly extracted the internal genitalia of the unique male of this new genus, compared it with those of *Aucacris*, and found that in this respect as well, the two show definite agreement and logically can be considered members of the same group of genera.

With the association of *Aucacris* and the new Argentine genus evident, certain apparent similarities in *Cumainocloidus*, which had been noticed under the mask of surface modifications, were re-examined, with the result that the inclusion of *Cumainocloidus* in the same group as the other two genera became the logical conclusion. This new group I am here calling the Aucacres, after the best known of its components.

When the three genera here associated are casually examined, their differences from one another seem so marked that the suggestion of their possible common origin might be dismissed as unwarranted. However, when we realize how markedly different in their general ensemble certain of the genera making up other genera groups are from one another, this association is more understandable. The Group Euthymiae presents probably as varied a series of diversifications in its components as one can find in any single group of locust genera,[9] yet they appear to have a common, if relatively ancient, ancestry. The Group Tristirae, which I have recently studied in some detail,[10] shows in its members as surprising a range of obvious specialization, except for alar development, as here assembled in the Aucacres. The body compression seen in some of the genera of the Tristirae is quite paralleled in the similar condition of the Peruvian Andean *Cumainocloidus* of the Aucacres, and quite significantly in the former group this tendency is also found in Peruvian Andean types.

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9 Vide Rehn, Proc. Acad. Nat. Sci. Phila., XC, pp. 41-102, pls. 1-7, (1938).

10 Trans. Amer. Entom. Soc., LXVIII, pp. 31-100, pls. III–IX, (1942).

Group Relationship.—Until a comprehensive and balanced concept of the various genera groups making up the Cyrtacanthacridinae has been formed, it is in most cases difficult to say to which of these entities any other one is more nearly related. The Aucacres, however, show, in the two genera of which the male sex is known, a quite distinctive type of epiphallus (see figures 9 and 14), with an arrangement of accessory structures which give to them, in this respect at least, a clearly-cut individuality. Whether this type of epiphallus will be found in *Cumainocloidus* cannot be determined until the at present unknown male sex of that genus has been examined. From the basic agreement of a large percentage of external features I feel confident the discovery of the male of that genus will show agreement with the other two in epiphallic design.

Tentatively at least I would place the Aucacres linearly at the beginning of the Cyrtacanthacridinae, preceding the almost equally aberrant Euthymiae, which is a circumtropical aggregation of more than a score of genera. Future work may show this position is not the most logical one for the Aucacres, but until more evidence bearing upon this question is available, I feel it is from all angles the best disposition to suggest.

General features of the Aucacres.—Form ranging from broad, subdepressed, short fusiform to subcompressed and elongate fusiform. Antennae simple, relatively short, 18 to 19 articles. Fastigium ranging from not at all produced cephalad of eyes and broadly rounding ventrad into face (*Neuquenia*) to moderately produced; disk of fastigium with lateral margins well marked, latero-cephalic ones present or absent; lateral foveolae definite, excavate and margined, or their area and that between are deeply cribroso-punctate (*Neuquenia*). Face in profile faintly retreating. Frontal costa evident throughout and sulcate, or obsolete ventrad and non-sulcate but cribroso-punctate dorsad (*Neuquenia*). Eyes relatively prominent in male (latter not known for *Cumainocloidus*). Pronotum deep, appreciably compressed and tectate dorsad (*Cumainocloidus*) to broad, subdepressed and even subsellate (*Neuquenia*); three transverse sulci indicated; caudal margin of pronotal disk transverse truncate (*Cumainocloidus*) or triangularly produced, the immediate margin and the caudal one of the lateral lobes of the pronotum more or less definitely sinuato-undulate; median carina precurrent (*Cumainocloidus*), present only on prozonal portion and there finely divided in two longitudinally (*Aucacris*) or obsolete throughout (*Neuquenia*); surface of pronotum coriaceous (*Neuquenia*) to linearly strumoso-rugose. Tegmina fully developed, with generalized venation (*Neuquenia*), short lanceolate (*Aucacris*) or very small and lobiform (*Cumainocloidus*). Wings fully developed, with generalized venation (*Neuquenia*), to lacking. Abdomen carinate medio-longitudinally. Prosternum tuberculiferous, the process transverse in greatest basal extent. Interspace between mesosternal and metasternal lobes more or less strongly transverse in both sexes. Cerci of male short, simple, conically styliform. Supra-anal plate of male subtrigonal, proximad with paired median parallel cariniform elevations separated by an intervening depression. Subgenital plate of male simple, subconical. Caudal femora with medio-dorsal carina well developed, serrate to

weakly serrulate; dorso-external carinae serrate to unarmed (*Neuquenia*); paginal pattern regular. Caudal tibiae with marginal spines appreciably diverging laterad at their bases, external margin with 10-11, internal with 9-12, apical spine present on both margins; internal distal spurs subequal in length; tarsal claws equal in length, arolia present. Epiphallus (in *Aucacris* and *Neuquenia*) with ancorae[11] well developed and lophi[11] bearing a horizontally divided process directed meso-caudad.

Probable history.—Clearly the Aucacres is an ancient group, and possibly to-day one on the decline. However, I feel that other genera of the assemblage will be discovered as our knowledge of southern South American and Andean Orthoptera becomes more comprehensive. The distribution of the genera here referred to the group certainly postulates a pre-Andean genesis, which would mean definitely prior to the early Pliocene, when the slowly rising Andes are supposed to have become a formidable mountain barrier. It would appear that perhaps as far in the past as Miocene times ancestral types of this autochthonous complex were distributed in suitable environments over at least parts of austral South America. The rising of the Andes barrier subsequently probably separated *Aucacris* and *Neuquenia*, or types ancestral to each of these, some of the former genus at least since having clearly adapted themselves to some type of montane conditions. The stem represented by *Cumainocloidus* has in many respects become more strikingly, but probably no more fundamentally, differentiated from the others, and its survival reactions have doubtless been responsible for many of its peculiarities.

Key to the Genera of Aucacres

1. Body definitely compressed. Pronotum tectate dorsad; caudal margin of disk not produced caudad, strongly sinuato-undulate. Tegmina very brief lateral lanceolate pads. Wings lacking. No evident external auditory tympana present. Head, nota and several proximal abdominal tergites strumosely multi-rugose; medio-longitudinal carina virtually continuous on nota and abdomen. (Peruvian Andes.)
Cumainocloidus Bruner

Body not compressed. Pronotum not tectate; its disk on metazona at least subdeplanate; caudal margin of disk angularly produced caudad, at most but moderately sinuato-undulate. Tegmina and wings fully developed or tegmina brachypterous and wings rudimentary, but reduction never aborts the tegmina to mere lateral pads. External auditory tympana present. Head and pronotum with surface ranging from cribrosely coriaceous to definitely strumoso-rugose, these latter hardly indicated on other nota or abdominal tergites; pronotal median carina at most indicated only on prozona of pronotum, much less pronounced on abdomen 2

[11] See Roberts, Proc. Acad. Nat. Sci. Phila., XCIII, pp. 241, 244, figs. 43, 75 and 80, (1941).

2. Form robust, brevialate or macropterous. Fastigio-facial area, as seen from dorsum, definitely but not exceptionally produced cephalad between the eyes; lateral foveolae delimited from the fastigial disk and frontal costa by distinct bounding carinae, surface variably impressed; frontal costa well defined to clypeal suture, sulcate. Pronotum not at all sellate in profile, with surface of disk having numerous longitudinally disposed strumose rugosities; median carina obsolete on metazona, present and more or less distinctly divided into two elements longitudinally on each of the three sections of the prozona; metazona not or but very slightly longer than the prozona. Caudal femora very robust, dorsal and dorso-external carinae strongly, or at least distinctly, dentate. (Chile.) ....*Aucacris* Hebard

Form of average build, macropterous. Fastigio-facial area, as seen from dorsum, not at all produced cephalad of the eyes, transversely subtruncate; lateral foveolae not evident, those areas deplanate, cibroso-punctate and passing without bounding carinae into the fastigial disk and frontal costa; surface of entire interocular-ocellar area deeply cribroso-punctate; frontal costa obsolete ventrad of median ocellus, non-sulcate dorsad. Pronotum in profile subsellate, with surface of disk coriaceous and entirely lacking definite rugosities; median carina obsolete throughout; metazona definitely longer than the prozona. Caudal femora more slender, less robust, dorsal and dorso-external carinae not at all or but very weakly denticulate. (Argentina.) *Neuquenia* new genus

CUMAINOCLOIDUS Bruner

1913. *Cumainocloidus* Brunner, Proc. U. S. Nat. Mus., XLIV, p. 179.

Genotype (by monotypy).—*C. cordillerae* Bruner.

This exceedingly distinctive genus is an entity in which external modifications, probably due to the corrosive influence of environment in the span of a doubtless long evolutionary history, have very largely masked features which would indicate relationship. It is interesting to note that the same type of body compression and dorsal carination as that seen in *Cumainocloidus* is evident in Peruvian genera of the Group Tristirae, such as *Punacris, Incacris, Crites* and *Paracrites*,[12] and thus we may have similar regional reactions in distinct groups. With this compression is associated in *Cumainocloidus* a degree of surface rugosity which as a whole is more extensive than in *Aucacris*, although the development of this pronotal sculpture shows a relatively similar areal disposition and, to an extent, emphasis.

When allowance is made for the compression, which to a degree involves the head of *Cumainocloidus*, as well as the remainder of the body, the features of the head are relatively similar to those of *Aucacris*. The basic design of the fastigium is essentially the same in the two genera, and the distinctive development of the lateral foveolae is identical. The lack of any

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[12] See Rehn, "The Locusts of the South American Generic Group Tristirae (Orthoptera; Acrididae; Cyrtacanthacridinae)." Trans. Amer. Entom. Soc., LXVIII, pp. 31-100, pls. III-IX, (1942).

caudal production of the pronotal disk in *Cumainocloidus* appears at first glance to be a very serious argument against the association of that genus with *Aucacris* or *Neuquenia*, but sufficient experience with other locusts will enable one to realize that the production, truncation or even emargination of this margin is much less fundamental than would appear to the uninitiated. However, the distinctively crenulate or multi-undulate character of this margin of the pronotum, including that of the lateral lobes as well, is even more emphasized than it is in *Aucacris*, and far more so than in *Neuquenia*. The transversely compressed prosternal process of *Cumainocloidus* is very similar to that of *Aucacris bullocki*, here described.

While unfortunately we do not know the male sex of *Cumainocloidus*, and are unable to compare the genitalia of that sex, the structure of the supra-anal, infra-cercal and subgenital plates and of the ovipositor valves and cerci are essentially the same as in the female of *Aucacris bullocki*, not only in general type but also in the distribution of the sculpture, the sole important difference being that a ventro-lateral tooth on the ventral ovipositor valves, which is distinct but not pronounced in *Aucacris*, is strongly developed in *Cumainocloidus*.

As Bruner's original description gives no summary of the major features which together characterize *Cumainocloidus*, the following analysis, with the accompanying figures, may prove of service in the recognition of the genus.

Generic characters.—Female sex alone known. Subapterous. Form moderately compressed. Surface largely rugose, the rugosities often sublinear, incrassate and all symmetrically disposed, although relatively dense on the nota, pleura and more proximal abdominal tergites.

Head deep, appreciably compressed, slightly broader across genae than across eyes; fastigio-facial angle rounded rectangulate in profile, facial line slightly arcuate between antennal bases, subvertical ventrad; fastigium as seen from dorsum with lateral margins subparallel, cephalic margins subrectangulately convergent, apex with finely and narrowly impressed median sulcus passing without break to the frontal costa, thus very narrowly separating the cephalic margins of the fastigium which ventrad pass uninterruptedly into the lateral margins of the frontal costa,[13] disk of fastigium

[13] It could be argued that this condition warrants the placing of the genus in the Ommexechinae, where Bruner had located it, but this condition is equally marked to faint in *Aucacris* and subobsolete in *Neuquenia*. The basic structure of the head, pronotum, sternum and caudal limbs in *Cumainocloidus* is entirely different from what we find in the Ommexechinae, virtually all the genera of which are before me. This feature may also suggest the Pamphaginae to others, but examination of the male internal genitalia of *Cumainocloidus*, at present unknown, will readily show whether this genus has any real affinity with that at present entirely Old World subfamily. However, *Aucacris* from the evidence of these parts has nothing to do with the Pamphaginae. The latter subfamily, as recently shown by Roberts (Proc. Acad. Nat. Sci. Phila., XCIII, pp. 227-238, (1941)), on the basis of internal genitalia, belongs to the major group Chasmosacci, as contrasted with the Cryptosacci, of which the Cyrtacanthacridinae is a component.

moderately excavate, with short cross rugae; dorsal interspace between eyes not narrowed, approximately equal to fastigial width or three times the inter-antennal breadth of the frontal costa; lateral foveolae indicated but not sharply delimited ventrad, in shape sublanceolate, the surface shallowly impressed with elevated small rugulae and points; frontal costa narrow, slightly widening ventrad, indicated for full length and similarly shallowly sulcate, more deeply so briefly ventrad of median ocellus; accessory facial carinae distinct, weakly undulate, slightly diverging ventrad. Eyes moderately prominent, basal outline ovoid, subequal in depth to length of infra-ocular sulcus. Antennae simple, composed of seventeen articles, slightly longer than mid-dorsal length of pronotum.

Pronotum tectate dorsad, in profile the dorsal outline as a whole is subarcuate, but broken into four low arcuate segments by transverse sulcal impressions, three on the prozona; cephalic margin of disk obtuse-angulate, caudal margin arcuato-truncate with pronounced crenulations extending ventrad over the caudal margin of the lateral lobes to the ventro-caudal angle; prozona twice as long as the metazona, the principal transverse sulcus continuously but not deeply impressed, the other sulci unevenly and incompletely indicated; lateral lobes of pronotum subquadrate, caudal margin obliquely subsigmoid in general outline, surface of the lobes passing into that of the tectate disk without break, the whole pronotal surface with numerous short rugae and pustules, some with a semblance of linear alignment, others irregular, but all in a balanced arrangement. Metanotum and proximal abdominal tergites with sculpture similar to that of pronotal surface. No evident auditory tympana present.

Tegmina minute lateral lanceolate coriaceous slips, failing to reach the middle of the metanotum. Wings lacking.

Prosternum with subvertical trigonal process transversely disposed and compressed, deplanate cephalad, apex acute as seen in cephalic aspect. Interspace between mesosternal lobes strongly transverse, equal in width to $1\frac{1}{2}$ times the breadth of one of the lobes, latter with internal margins broadly arcuate. Interspace between metasternal lobes similarly transverse, slightly narrower than that between the mesosternal lobes, foramina large, inclined toward median axis, ovoid-rimate.

Abdomen as a whole medio-longitudinally carinate to base of supra-anal plate, latter narrow, deeply reentrant proximad, tectate, lateral margins inbowed mesad, apex obtuse-angulate, surface of plate sharply divided in two by a transverse, arcuate impressed pseudo-imbrication, proximal half sulcate mesad, distal half subbullate; cerci very short, blunt trigonal; ovipositor valves stout, dorsal pair dorsad with a marked transverse cusp-like ridge proximad of the concavity, ventral pair with proximo-lateral section of the ventro-lateral margins developed into a distinct lobiform tooth, lateral plates on ventral valves broad, apex acute, dorso-caudal margin arcuate, ventral margin straight; subgenital plate with distal margin rectangulately produced mesad, laterad of which the margin is subconcave.

Caudal femora reaching distad as far as the ovipositor, subcompressed, slender in lateral aspect, medio-dorsal carina with spaced serrato-denticulations, dorso-external and dorso-internal carinae similarly but more weakly armed, ventral carinae entire, pagina with pattern regularly impressed, genicular lobes rounded acute distad, angle at distal extremity of genicular

arches rounded rectangulate; caudal tibiae with eleven spines on each extensor margin, including the external apical one, distal spurs of each side subequal in length, the internal ones longer than external pair; caudal tarsi with claws of equal length, arolia well developed.

Cumainocloidus cordillerae Bruner Plate 8, figs. 1, 2; pl. 10, figs. 10 and 11.

1913. *Cumainocloidus cordillerae* Bruner, Proc. U. S. Nat. Mus., XLIV, p. 180. [♀; Ollantaytambo, Peru, elevation of approximately 9000 feet.]

Of the two females on which this species, and genus, was erected I have the paratypic one now before me from the Hebard Collection, received in exchange from the United States National Museum, which possesses the single type. The figures here presented of the paratype should assist in the recognition of this previously unfigured genus and species.

Chapman in his study of the distribution of bird life in the Urubamba Valley, Peru,[14] based chiefly on material collected by the expedition which secured the original specimens of *C. cordillerae*, considered Ollantaytambo to be in the Arid Temperate Zone, with the last evidences of the higher Puna Zone traceable in its birds. It is in consequence possible that *Cumainocloidus* may be a Punan type here reaching its lowest distributional level.

AUCACRIS Hebard

1929. *Aucacris* Hebard, Entom. News, XL, p. 253.

Genotype (by original designation).—*A. eumera* Hebard.

The following generic features, drawn from *A. eumera* and *bullocki*, are largely additional to those already given by Hebard.

Form moderately to strongly robust, alate to brachypterous, pronotum rugose and strumosely pustulate, head more weakly so.

Fastigium broad, scutellate, lateral bounding carinae distinct, surface moderately excavate, a very narrow median cephalic sulcation passing to frontal costa, which latter is evident throughout, its median surface sulcate or impressed; lateral foveolae subtrigonal, subimpressed, ventral margin evident but hardly carinate. Antennae simple, subequal to (♂) or somewhat shorter than (♀) pronotal dorsum.

Pronotum subdeplanate dorsad, metazona and prozona subequal in length; caudal margin of disk as a whole rectangulate (♂) to obtuse-angulate (♀), the margin definitely but not strongly undulato-crenulate; principal and two preceding transverse sulci entire, the latter severing the median carina of the prozona, which is lacking on the metazona; surface of prozona with linear rugosities and strumose pustulations always present but of variable strength in different species, a very fine longitudinal bisection of the prozonal median carina evident, metazonal surface with numerous usually linearly disposed rugosities and pustulations of lesser emphasis as a whole than those on the prozona, usual position of the lateral carinae occupied by marked but broken linear rugosities: lateral lobes somewhat longitudinal, ventro-caudal angle rounded subrect to obtuse-angulate, surface of at least

[14] Bull. U. S. Nat. Mus., no. 117, p. 17, (1921).

dorsal half of lobes rugose as dorsum, first transverse sulcus not crossing an oblique grouping of rugosities, the others and a juxta-marginal one cephalad well marked on most of the lobes.

Tegmina in brachypterous species elongate elliptical, overlapping or separated meso-dorsad; of macropterous species (*hebardi*) reaching at least to the base of the ovipositor valves, lanceolate with basic venation well developed.

Interspace between mesosternal lobes transverse, equal in width to or broader than one of the lobes; interspace between metasternal lobes transverse, but narrower than that between mesosternal lobes, foramina distinct but small, directed mesad. Supra-anal plate in both sexes trigonally scutellate, apex acute (♂) to rectangulate (♀), surface definitely sulcate medio-longitudinally in proximal half, non-sulcate distad, transverse impression marked, arcuate (♀) to angulate (♂); cerci in both sexes short, stout, conical, not surpassing distal margin of infra-cercal plates; male subgenital plate bluntly conical, apex rounded and distad of dorsal margin; female subgenital plate with distal margin angulate produced mesad; ovipositor valves relatively short, stout, apices lightly curved, margins entire.

Cephalic and median limbs relatively short and stout, femora subinflated; caudal femora robust, subcompressed, surpassing (♂) or reaching (♀) apex of abdomen, medio-dorsal and dorso-external margins serrato-dentate but of varying strength, dorso-external face rather broadly, dorso-internal face more narrowly deplanate, median carina thus sublamellate, ventro-external carina strongly marked but not definitely armed, ventral carina in profile arcuately sublamellate; caudal tibiae stout, internal spines heavier and longer than external ones, 10 external including apical one, and 9-10 [15] internal spines, distal spurs very short, internals slightly longer than externals; caudal tibiae with proximal and distal articles subequal in length, arolia relatively large in male, much smaller in female, tarsal claws equal.

Distribution.—The genus *Aucacris* is known only from Chile, with the exact locality available for but one of the three species here treated.

Key to Species

1. Species macropterous, alar organs reaching at least to base of ovipositor valves. Caudal femora of female 20 millimeters in length. *hebardi* Willemse

   Species brachypterous, alar organs not at all, or but very slightly, longer than medio-dorsal length of pronotum. Caudal femora of female under 20 millimeters in length.................................2

2. Body as a whole more robust, pronotum more strongly expanding caudad. Head broader; interocular vertex and occiput markedly rugulose. Pronotum more strongly ampliate caudad, surface of disk and lateral lobes more densely strumoso-rugose, angle of caudal margin of disk obtuse, the margin more strongly undulate. Tegmina well separated (♂ and ♀), narrower. Caudal femora more robust, medio-dorsal carina more strongly serrato-dentate, ventro-external face broader; caudal tibiae more robust......................*bullocki* new species

[15] By anomaly, in female of *bullocki*, but seven.

Body as a whole less robust, pronotum less strongly expanding caudad. Head narrower; interocular vertex and occiput not markedly rugulose. Pronotum less strongly ampliate caudad, surface of disk and lateral lobes less densely strumoso-rugose, angle of caudal margin of disk subrectangulate, the margin less strongly undulate. Tegmina overlapping (♂) to subattingent (♀), broader. Caudal femora more slender, medio-dorsal carina less strongly serrato-dentate, ventro-external face narrower; caudal tibiae more slender.... *eumera* Hebard

Aucacris hebardi Willemse

1931. *Aucacris hebardi* Willense, Mitth. Deutschen Entom. Gesell., II, p. 22, fig. [♀; Chile.]

This species is known to me only by the description and figure of the unique type. It has a distinctly more robust build than *A. eumera*, in this respect being nearer *A. bullocki*, from which, however, it shows numerous features of difference, as given in the diagnosis of *bullocki*.

Whether the macropterous condition of the unique type is the usual condition of the species, as I think probable, or an atavistic condition in an otherwise brachypterous form, remains to be determined.

Unfortunately, as with *A. eumera*, there is no exact locality information for this species, so any comments on areal distribution are not possible in either case. I feel, however, that each of the three known species of the genus will be found peculiar to a distinct area of Chile. However, we do know that *hebardi* occurs in early February, the type having been taken February 6, 1899.

Aucacris bullocki[16] new species Plate 9, figs. 5-7; pl. 10, figs. 8, 9.

When compared with the two previously known species of the genus, the present form is apparently more nearly related to *A. hebardi.* While *bullocki* is brachypterous, and *hebardi* is macropterous, the tegmina are even shorter, distad more rounded and non-attingent dorsad when compared with *A. eumera*, the genotype. In addition when compared with *eumera* the pronotum is broader caudad in both sexes, its surface is more strongly strumoso-rugose, its caudal discal margin more markedly undulate and its entire width greater in proportion to its length. The caudal femora are very much more robust than in *eumera*, proportionately shorter and deeper, with the serration of the dorsal and dorso-external carinae much stronger and more pronounced, while the caudal tibiae are definitely stouter and thicker with heavier spines. In addition the prosternal process is transverse compressed, while in *eumera* it is more elongate conical.

When compared with the description and figure of the unique female type of *A. hebardi* Willemse, the present species is seen at once to differ in its strongly brachypterous condition and the much shorter caudal femora,

16 Dedicated to Mr. D. S. Bullock, of Angol. Chile, collector of the type material, who has added so materially to our knowledge of the natural history of Chile.

the latter being hardly more than three-fourths the length of those of *hebardi*, although the general body bulk is quite similar. It is quite probable that actual comparison with *A. hebardi* would bring to light differences in other features not mentioned in Willemse's description or evident in his illustration of the type.

Type.—♂; Termas Rio Blanco, near Curcautin, Department of Mariluán, Province of Malleco, Chile. Elevation, 2000 meters. February 25, 1942. (D. S. Bullock.) [Academy of Natural Sciences of Philadelphia, Type no. 5684.]

Size medium; form robust, brachypterous; surface of head, pronotum and pleura rugose.

Head well seated in the pronotum, relatively broad, width across genae ventrad slightly greater than that across eyes; occiput in profile full and rounded, passing regularly into the oblique declivent surface of the fastigium, a poorly marked medio-longitudinal carina and numerous strumose tubercles indicated in transverse subarcuate series, interocular width dorsad subequal to the transverse dimension of the eye in same view; fastigium scutellate, its surface moderately excavate, no median carina present, lateral margins marked, with a definite median angle where cephalad they converge to the fastigio-facial area at which point they are narrowly separated, several short carinate spurs extend mesad from these margins; fastigio-facial angle in profile broadly obtuse, on a line with the middle of the eyes; lateral foveolae subtrigonal, distinct, but dorsal and ventral margins much less pronounced than the caudal one; frontal costa continued to clypeal suture, moderately sulcate, more deeply so about the median ocellus, which is placed on a line between the ventral borders of the eyes, sulcus dorsad virtually continuous with the impression of the fastigium, lateral margins of costa definitely carinate, slightly converging immediately dorsad and also briefly ventrad of median ocellus, thence ventrad somewhat diverging; lateral (accessory) facial carinae very strongly marked dorsad, less pronounced ventrad, concavely diverging ventrad. Eyes but moderately prominent as seen from dorsum, basal outline as seen in profile subovoid, its greatest width contained 1¼ times in greatest depth, the latter subequal to the length of the infra-ocular sulcus. Antennae short, in length slightly less than that of pronotal dorsum, articles 19 in number, faintly depressed, particularly meso-distad, apical article truncately blunted.

Pronotum regularly widening caudad as seen from dorsum, the greatest width caudad (i.e. across ventro-caudal angles of lobes) equal to 1½ times that cephalad, median length of pronotal disk equal to 1½ times that across disk of metazona; cephalic margin of disk very faintly obtuse-angulate, caudal margin of same as a whole subrectangulate, the immediate angle slightly more blunted, the whole caudal margin, including that of the lateral lobes, quite distinctly and regularly crenato-undulate, most decided on the discal section, the total number of all crenations twelve; metazona very slightly longer than the prozona, principal sulcus and the two preceding on the prozona well impressed dorsad, the principal one and that immediately preceding it continuing ventrad well marked across most of the lateral lobes, the cephalic one of the three terminating dorsad on the lobes in a cephalic

curve, a submarginal cephalic sulcus also well indicated on the lateral lobes; median carina thick and substrumose on the first and third sections of the prozona, the second section with a less evident carinal portion, all with a fine but distinct longitudinal sulciform division, metazona lacking a distinct median carina, area of the usual lateral angles of the pronotum with strumose and blunt carinations on the prozona, these, however, not continuous, one series, indicated only on the first and second sections of the prozona, a more lateral, largely tuberculiform, series is present on the second and third sections of the prozona, descending somewhat ventro-cephalad on the lobes, where both are flanked ventrad by several similarly directed but more prominent strumose ridges, one extending from the submarginal sulcus to the principal one, the other (more ventral) indicated solely between the principal and preceding transverse sulcus, no rugae present on the metazona in the usual position of lateral carinae; surface of prozonal disk with scattered low pustulose tubercles, symmetrically placed and of varying size, of metazona with rather closely disposed, often lachrymiform, sublongitudinally disposed rugae, a few of which, subsymmetrically placed, are larger than the others: lateral lobes with their dorsal length about $1\frac{1}{3}$ times their depth, vicinity of cephalic margin with numerous closely placed and subparallel rugulae, major sculpture of remainder of prozona of lobes already discussed, metazona of lobes with numerous rugae similar to those of metazona of disk.

Tegmina with their greatest exposed length not more than $\frac{2}{3}$ that of the greatest pronotal length, elongate elliptical in outline, greatest breadth equal to half of exposed length, apex narrowly rounded, sutural margins separated by a distance subequal to $\frac{5}{6}$ of the tegminal breadth; venation well elevated, longitudinal veins pronounced and regular, quite straight, cross-veins more irregular in presence and trend. Wings mere rudiments, not half as long as the tegmina and completely concealed under the same.

Dorsum of metanotum and abdomen markedly carinate medio-longitudinally. Supra-anal plate trigonal, apex sharply acute, converging lateral margins slightly sigmoid; surface with median transverse impression as a whole obtuse-angulate with narrow median section of angle transversely truncate, proximal half of surface with a pronounced, deep and relatively broad sulcation, which is bordered laterad by thickened but rounded ridges which distad diverge somewhat and disappear, in trend virtually paralleling the arms of the transverse impression, distal half of surface largely low convex, neither sulcate or carinate. Cerci short, stout, simple, bluntly conical, apices little surpassing marginal end of transverse impression of supra-anal plate; infra-cercal plates broad, transversely subtruncate distad. Subgenital plate relatively short, bluntly subconical in both dorsal and lateral aspects, the apex well rounded, dorsal margins acutely straight convergent as seen from dorsum, failing to reach apex of plate; ventral surface and that of preceding sternite with a large elliptical impressed area.

Prosternum with a well elevated median protuberance, which is rounded at the apex and slightly transverse in section, its cephalic face slightly concave proximad. Interspace between mesosternal lobes strongly transverse, $1\frac{1}{3}$ times as wide as one of the lobes, internal margins of latter broadly rounded; interspace between metasternal lobes similarly transverse, with width equalling $\frac{5}{3}$ that of mesosternal interspace, internal margins of lobes straighter and less definitely arcuate, caudal margins of metasternal lobes straight oblique.

Limbs robust; femora appreciably inflated, cephalic and median ones subtumid, their ventral surfaces well rounded, not strongly deplanate, their cephalic genicular lobes well produced, subacute. Caudal femora very briefly surpassing the apex of the abdomen, stout, their greatest depth (at proximal third) equal to slightly more than $\frac{1}{3}$ their length, their greatest thickness, as seen from the dorsum, equal to but $\frac{1}{5}$ their length; medio-dorsal and dorso-external carinae serrato-dentate, more pronounced in the former, which also is sublamellate, ventro-external carina obsoletely serrulate, the other carinae virtually entire, ventral carina definitely arcuate, sublamellate; pattern of paginae regular and well engraved, dorso-lateral and ventro-external faces relatively broad, the former definitely shagreenous: caudal tibiae stout, relatively deep, spines robust and elongate, the internals, as usual, longer than the externals, external series numbering ten, including apical which is rotated inward from the axis of the series, internal series nine: caudal tarsi stout, proximal and third articles subequal in length.

Allotype.— ♀ ; same data as type.

Differing from the description of the male (type) in the following noteworthy features.

Size larger; general form similar but somewhat broader, sculpture as in male.

Head proportionately thicker through the genae, this breadth equal to $1\frac{1}{4}$ times that across eyes; in profile the declivency of the fastigium is as a whole more definitely straight and therefore less strongly marked distad than in the male, with a more clearly drawn fastigio-facial angle, interocular width dorsad equal to $1\frac{1}{3}$ times the transverse dimension of the eye; fastigium as in male but proportionately broader in correspondence to the broader head; frontal costa with section dorsad of median ocellus more irregularly impressed than definitely sulcate. Eyes almost as prominent as in male, proportions similar. Antennae shorter than in male, very much under pronotal length.

Pronotum in all important respects as in male except that the caudal margin of the pronotal disk is more obtuse-angulate, the immediate angle blunter.

Tegmina with their greatest exposed length equal to $\frac{3}{5}$ median length of the pronotal disk, outline as in male.

Supra-anal plate transverse trigonal, the basal width equal to $1\frac{2}{5}$ times the median length of the plate, margins nearly straight convergent distad, immediate apex briefly decurved, surface as a whole subtumid, almost without sculpture. Cerci similar to but even smaller than in male. Ovipositor valves short, stout, apices briefly recurved, dorso-external margins of dorsal valves entire, proximal tooth on ventro-external margins of ventral valves low and blunt, lateral plates of ventral valves moderately acute distad. Subgenital plate with distal margin acute-produced between ventral ovipositor valves, subtruncate more laterad.

Prosternum with median protuberance more definitely transverse although of the same general pattern as in male, cephalic face more strongly concave, particularly proximad, transverse outline of protuberance subcingulately thickened. Interspace between mesosternal lobes very strongly transverse, $1\frac{1}{2}$ times as wide as one of the lobes; interspace between metasternal lobes equal to $\frac{4}{5}$ mesosternal interspace.

Limbs, particularly the cephalic and median ones, less robust proportionately than in male. Caudal femora reaching to the bases of the ovipositor valves, all carinae more sublamellately elevated than in male, the greatest femoral depth equal to $\frac{1}{3}$ their length, their greatest thickness, as seen from dorsum, equal to but $\frac{1}{6}$ their length, serration of margins as in male but even more decided; caudal tibiae as in male, external spines numbering 9, internals 9-10.

Measurements (in millimeters).—♂ (*type*); length of body, 27 mm.; length of pronotum, 10.6; length of tegmen, 6.5; length of caudal femur, 15.8. ♀ (*allotype*); length of body, 35 mm.; length of pronotum, 11; length of tegmen, 6.5; length of caudal femur, 17.

Coloration.—Pale base color ochraceous-buff, occasionally paling to light ochraceous-buff, in part overlaid by maculations, banding or stipplings chiefly of blackish brown to blackish fuscous, the distribution of the darker pattern as follows: head quite generally mottled or washed with dull slate-olive (almost entirely in the male type) to blackish brown, occasionally touched with madder brown on some tubercles, the strength and extent of the mottling individually variable; pronotum more blotchily marked with blackish brown, these symmetrically disposed, the larger masses roughly grouped mesad and cephalad on the pronotal disk and subobliquely across dorsal portion of lateral lobes, the undulations of the caudal margin and the rugulae along the cephalic margin distinctly marked with fuscous, most of the metazonal disk and a median section on that of the prozona paler than elsewhere, the female showing some madder brown touches on certain tubercles. Tegmina almost solidly fuscous. Abdomen dorsad almost entirely fuscous. Ventral surface buffy, in part with or without a pale bluish wash. Cephalic and median limbs buffy, heavily (femora) or less strongly (tibiae) mottled or incompletely banded with fuscous, which is definitely tinged with madder brown or purplish. Caudal femora with base tone buff, dorsum strongly trifasciate with fuscous, external face obscurely continuing same, mainly as groups of dark points, the fasciae again evident on the ventro-external face, internal face largely flame scarlet with a preapical fuscous band and a proximal cloud of the same together with some indefinite traces of other dark maculae, ventral surface colored as internal face but proximal fuscous more extensive, genicular arches fuscous; caudal tibiae flame scarlet, in part paling to buffy on external face, spines fuscous tipped; caudal tarsi very pale flame scarlet. Eyes tawny olive to snuff brown. Antennae largely fuscous.

The type and allotype are the only individuals of this species which have been examined.

Aucacris eumera Hebard

1929. *Aucacris eumera* Hebard, Entom. News, XL, p. 253, pl. XV. [♂ (*type*), ♀; Chile.]

With solely the paratype male before me, I can add nothing to the original description. This species and *A. bullocki* are very distinct, although *A. hebardi* logically represents the opposite end of the series of species from *A. eumera*. Unfortunately we do not know what area of Chile is inhabited by this species.

NEUQUENIA[17] new genus

This most remarkable genus, which has a strong superficial resemblance to the North American romaleid *Tytthotyle*, is so strikingly different in general appearance that its relationship to *Cumainocloidus* and *Aucacris* was evident only after considerable study, as well as the examination of the male internal genitalia.

The main features which at once distinguish *Neuquenia* from both *Aucacris* and *Cumainocloidus* have already been presented in the key to the genera of the Aucacres. The following general summary of characteristics may prove of further value to the critical student.

Generic characters.—Male sex alone known. Macropterous. Form normal, neither depressed or compressed. Surface in part rugulose, in others areas cribosely impresso-punctate to punctulate, of fastigium and pronotum virtually lacking sharply marked carinae or carinulae.

Head short, relatively broad across eyes, this breadth equal to $1\frac{1}{3}$ times that across genae, the lateral margins of the latter subparallel as seen in cephalic aspect; depth of head nearly one and one-half times width across genae; occiput rounded; fastigium short and broad, arcuately declivent, its surface subimpressed, the same area subtruncate cephalad, fastigio-facial angle virtually non-existent, the curving fastigium passing broadly into the dorsal section of the frontal costa and involving the areas usually occupied by the lateral foveolae, these equally subinflated and strongly cribroso-punctate; frontal costa dorsad with surface cribroso-punctate, there equal to half of fastigial width, obsolete ventrad of median ocellus; facial line in profile subvertical. Eyes full. Antennae short, subequal to pronotal disk in length, 19 articles, apex bluntly subtruncate, articles of distal half strongly concave ventrad.

Pronotum subsellate in general form but dorsal line in profile nearly straight; cephalic margin of disk low arcuate with a definite median obtuse-angulate emargination, caudal margin of disk subacute produced, crenulations of margin indicated but weak; metazona on median line nearly $1\frac{1}{2}$ times as long as prozona; no median or lateral carinae; transverse sulci three in number, distinct but finely impressed; lateral lobes of subequal length and depth.

Tegmina surpassing apices of caudal femora, lanceolate, of subequal width for most of their length, apex well rounded; marginal field with its greatest width subequal to that of anal field, which latter is continuous to near tegminal apex; mediastine vein well developed, areolation of proximal $\frac{3}{5}$ of tegmina rather irregular and of large size, areolets of distal $\frac{2}{5}$ largely oblong rectangles, the secondary venation of this part regularly developed. Wings reaching to the apices of the closed tegmina, of medium breadth, apices of anterior and axillary fields individually rounded, also, less markedly, of the individual sections of the peripheral margin of the radiate field; venation of anterior and axillary fields normal, of radiate field relatively simple, cross-veins rather irregular in spacing and trend.

Auditory tympana well developed. Prosternum with production an erect, transversely disposed and compressed sublamellate process, its distal outline

[17] After the province of Argentina which the genotypic species inhabits.

triangularly arcuate transversely. Interspace between mesosternal lobes transverse, that between metasternal lobes quadrate. Supra-anal plate of male trigonally scutellate; cerci of male very short, stout, simple, styliform; infra-cercal plates of male strongly developed, reaching to apex of supra-anal plate; subgenital plate very blunt, subconoid, apex distad of dorsal margin, rounded in profile.

Caudal femora stout, all carinae indicated, the dorsal alone very sparsely and weakly serrulate, incised pattern of external paginae relatively regular; caudal tibiae with well-developed apical spine on each margin, the components of these spine series definitely arcuate laterad and the extensor surface of the tibiae between subdeplanate, internal tarsal spurs definitely longer than external ones, both with their components subequal in length and curvature; caudal tarsi with proximal and distal articles subequal in length, second article very short, arolia well developed, tarsal claws equal in length and curvature.

Genotype.—*Neuquenia fictor* new species.

Neuquenia fictor [18] new species Plate 8, figs. 3, 4; pl. 10, figs. 12-14.

Type.—♂; Neuquen, Argentina. 1907. (Dr. Lendl Adolf.) [Hebard Collection, Type no. 1360.]

Size rather small; surface with cribrose impressed punctations of the fastigio-facial region, the dorsal part of the frontal costa, of the pronotal metazona and the ventral portions of the remainder of the lateral lobes, and more coarsely on the pleura, quite closely and markedly impressed, of the genae and lower face more sparsely indicated.

Head with interspace between eyes dorsad relatively broad, equal to $\frac{10}{13}$ the transverse width of one of the eyes as seen in dorsal aspect, lateral margins of the interspace subparallel, briefly carinulate, this area passing abruptly into the fastigium, the sole delimiting indication being a low transverse truncation separating the smoothly subimpressed surface of the interocular space from the subinflated sponge-like texture of the heavily cribrose impresso-punctate fastigium, which latter quite abruptly rounds ventrad into the facial slope and laterad completely absorbs the usual lateral foveolar areas, all of which are heavily punctate; lateral ocelli well marked, placed close to eyes; frontal costa as described under genus, its lateral margins slightly ampliate about and converging briefly ventrad of the median ocellus, thence subobsolete; lateral (accessory) facial carinae sinuately diverging ventrad. Eyes relatively large, moderately prominent but not strongly exserted, faintly deplanate dorsad, basal outline very broad ovoid, this width equal to $\frac{5}{6}$ of depth, which latter is twice the length of the infra-ocular sulcus. Antennae described under genus.

Pronotum with all three transverse sulci definitely sinuate, the undulations of the cephalic one broader than in the others, this sulcus also terminating dorsad on the lateral lobes in a slit-like impression, whence ventrad a definitely intra-marginal sulcus is present along most of the cephalic border of the lobes, between transverse sulci two and three (principal one) mesad is placed a low rounded node; lateral lobes with ventral margin

[18] Meaning *a feigner*, in allusion to its great superficial resemblance to the romaleid genus *Tytthotyle*.

arcuate as a whole, ventro-cephalic angle obtuse, ventro-caudal rounded obtuse, cephalic and caudal margins of lobes in general subparallel.

Tegmina with greatest width contained $5\frac{1}{2}$ times in length of same, costal and sutural margins nearly straight and subparallel from approximately proximal third to distal fourth, thence the costal margin curves evenly to the well-rounded apex, which is slightly nearer the sutural margin: marginal field with a very weak and low proximal lobation: mediastine vein reaching to approximately the distal fourth of the tegmen, ramifying distad; no intercalary vein indicated; anal and axillary veins strongly developed, coalescing very shortly proximad of middle of tegmen and the single combined vein marked to the extremity of the field near the apex of the tegmen; areolate neuration of proximal half of discoidal and much of marginal fields open and irregular, of proximal third of anal field more closely and densely anastomosed.

Prosternal process definitely transverse, its outline on the same axis subtrigonal with apex rounded, cephalic and caudal faces of process definitely deplanate. Interspace between mesosternal lobes but slightly wider than one of the lobes, moderately and evenly widening caudad, lobes in width equal to approximately $\frac{5}{8}$ that between mesosternal lobes. Supra-anal plate trigonally but broadly scutellate, its proximal width slightly greater than median length (as 22 to 18), lateral margins converging little distad to the deeply-cut transverse impression, thence subsinuately converging to the rounded sublobate apex; surface of proximal half with a marked and carinately delimited median sulcus, distal half without indication of sulcus, its surface rugulose: infra-cercal plates compressed, their deep lateral faces sharply marked off by a carina from the much narrower dorsal section, ventral margin sinuately and obliquely ascending to the apex, external surface deeply grooved to receive cercus: cerci very short, not quite half as long as the infra-cercal plates, stout, conically styliform: subgenital plate as described under genus.[19]

Caudal femora reaching, but hardly surpassing, the apex of the abdomen, their greatest depth contained $3\frac{3}{4}$ times in the length of same, moderately thick as viewed from dorsum, medio-dorsal carina well elevated, thinly lanuginose, pattern of external paginae well etched, quite open and not perfectly balanced in the dorsal and ventral sections, genicular lobes with apices well rounded: caudal tibiae with 11 external and 11-12 internal spines, including the apical in each case, the external apical placed much mesad of the general axis of the external series.

Coloration.—General color tone ranging from smoke gray to hair brown and even buffy brown in some areas, some of face, genae, parts of the pleura and parts of the external face of the caudal femora tending toward pale plumbeous, much of dorsum of pronotum and areas of the lateral lobes washed with olive-brown to clove brown, the punctae of the head and pronotum almost always darker and contrasted to a variable degree, producing a stippled pattern. Caudal margin of disk and lateral lobes of pronotum contrasting and alternately light and dark. Tegmina sayal brown (of Ridgway) with subquadrate blotches of snuff brown longitudinally arranged in one series of smaller size between the mediastine vein and the

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[19] This plate has been slightly crushed, possibly in extracting the internal genitalia, and solely those features given under the genus can dependably be drawn from the type.

humeral trunk, and another of larger size in the anal field, the discoidal field with faint indications of other maculae proximad. Wings hyaline with a brownish tinge, the principal veins pencilled in snuff brown to bister. Eyes tawny-olive. Antennae snuff brown proximad becoming bister distad. Ventral surface hoary white. Caudal femora with dorso-internal face pale, near cinnamon-buff, with a distinct postmedian subfuscous clouding, internal face similarly colored but also with an extensive proximal clouding of the same color, ventral sulcus colored much as the dorso-internal face; caudal tibiae and tarsi dull cinnamon-buff, the former darkened proximad and with their internal face slightly pinkish, spines pale, black tipped.

Measurements — Length of body, 18 mm.; length of pronotum, 4.9; length of tegmen, 17.9; length of caudal femur, 11.6.

The type of this very striking and most unusual genus and species is unique.

EXPLANATION OF PLATES 8 TO 10

PLATE 8.

Cumainocloidus cordillerae Bruner. Female (paratype). Ollantaytambo, Peru. Fig. 1.—Lateral view. Fig. 2.—Dorsal view. (× 3.)

Neuquenia fictor new genus and species. Male (type). Neuquen, Argentina. Fig. 3.—Lateral view. Fig. 4.—Dorsal view. (× 3.)

PLATE 9.

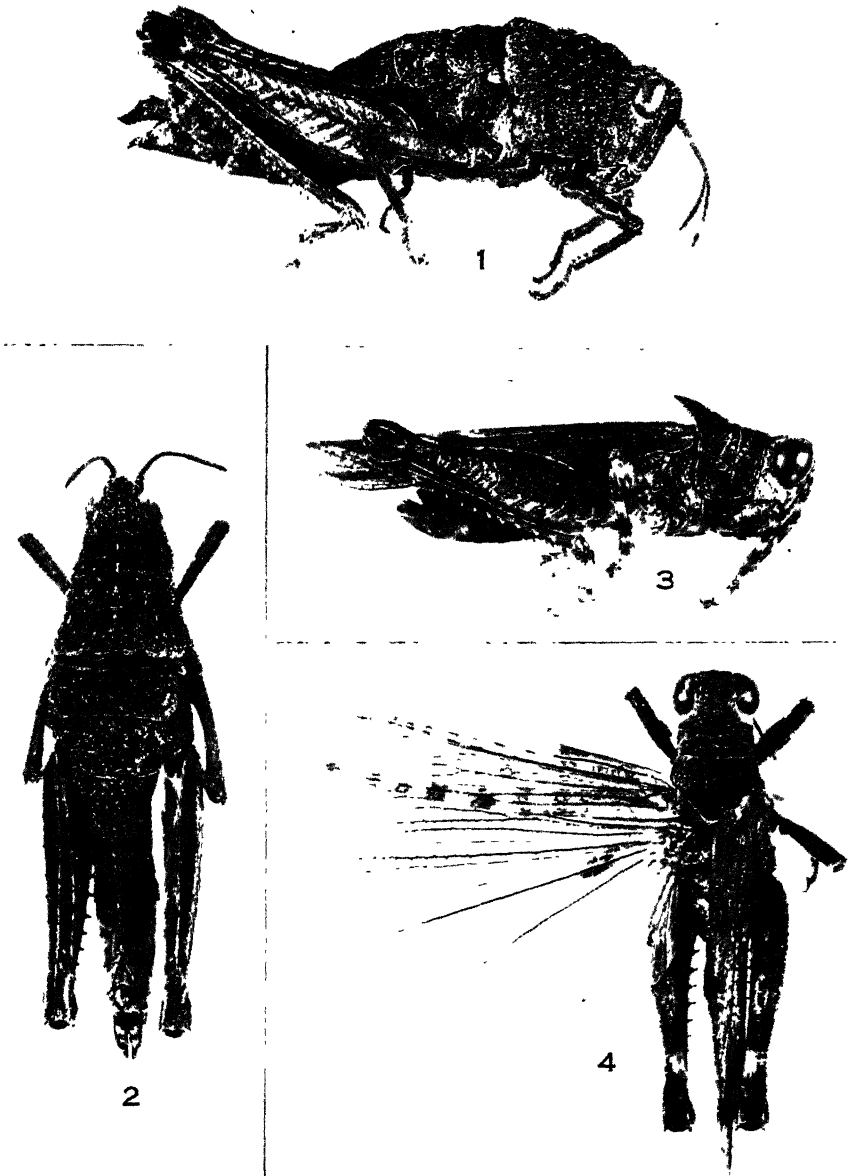
Aucacris bullocki new species. Male (type). Termas Rio Blanco, Malleco Province, Chile. Fig. 5.—Lateral view. Fig. 6.—Dorsal view. (× 3.) Female (allotype). Same locality. Fig. 7.—Dorsal view. (× 3.)

PLATE 10.

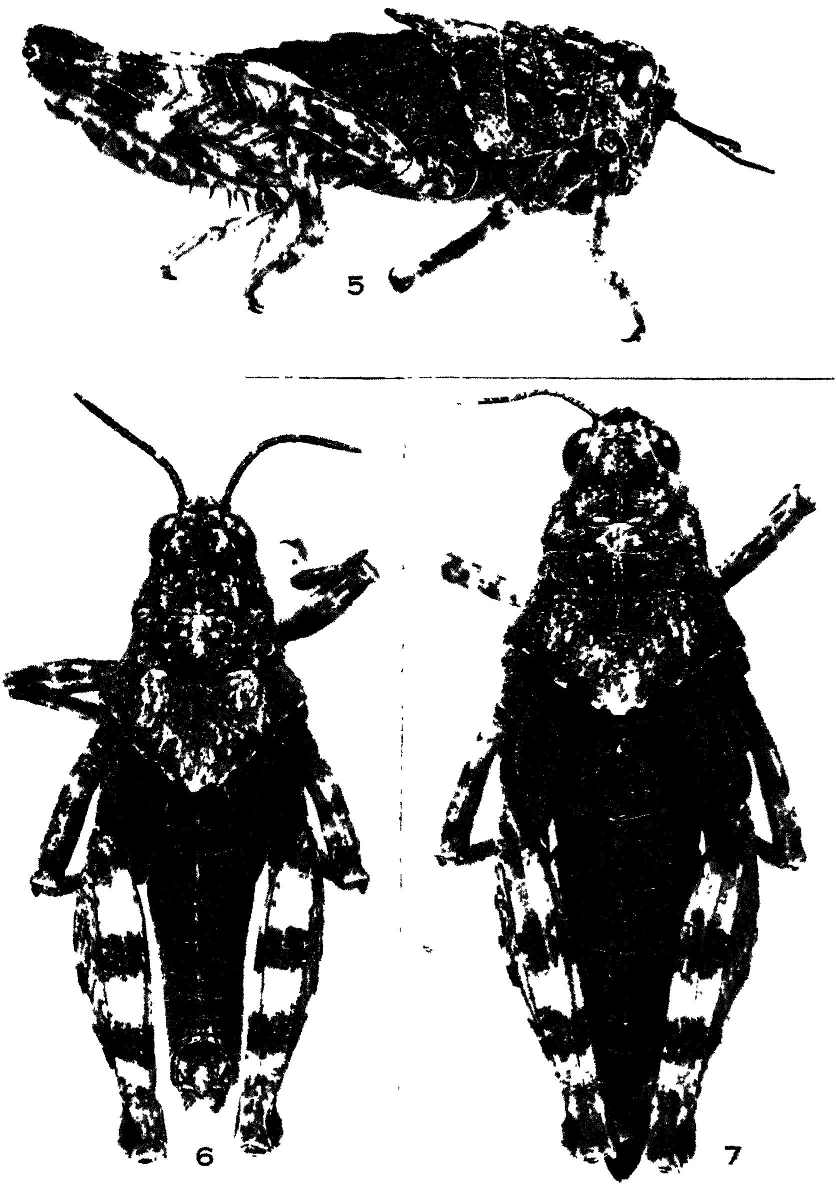
Aucacris bullocki new species. Female (allotype). Termas Rio Blanco, Malleco Province, Chile. Fig. 8.—Lateral view. (× 3.) Male (type). Same locality. Fig. 9.—Epiphallus. (Greatly enlarged.)

Cumainocloidus cordillerae Bruner. Female (paratype). Ollantaytambo, Peru. Fig. 10.—Cephalic view of head. Fig. 11.—Dorsal view of fastigium. (Greatly enlarged.)

Neuquenia fictor new genus and species. Male (type). Neuquen, Argentina. Fig. 12.—Cephalic view of head. Fig. 13.—Dorsal view of fastigium. Fig. 14.—Epiphallus. (Greatly enlarged.)



REHN: THE AUCACRES, A NEW GROUP OF SOUTH AMERICAN LOCUSTS
(ORTHOPTERA, ACRIDIDAE, CYRTACANTHACRIDINAE)



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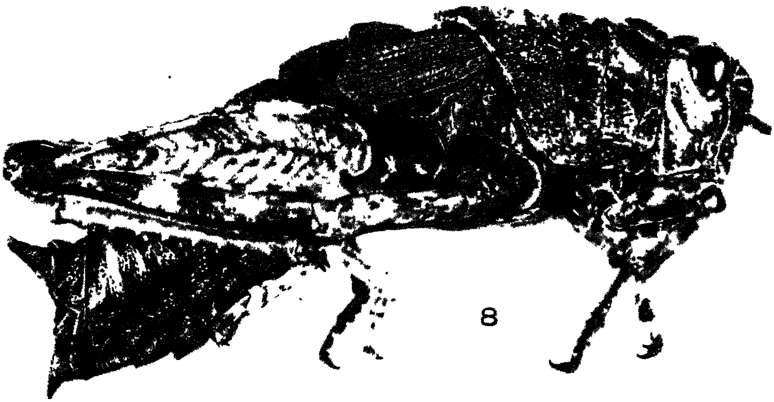
(ORTHOPTERA, ACRIDIDAE, CYRTACANTHACRIDINAE)



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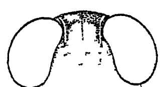

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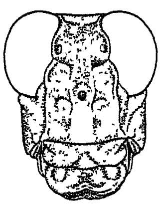

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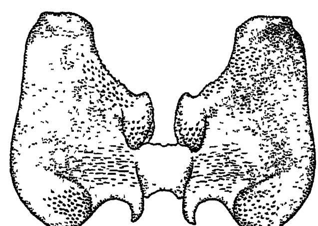

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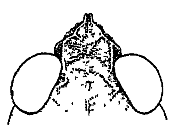

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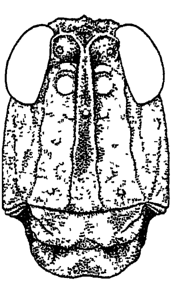

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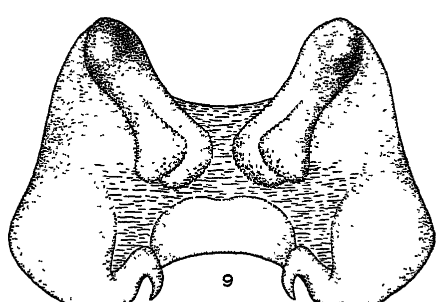

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REHN: THE AUCACRES, A NEW GROUP OF SOUTH AMERICAN LOCUSTS (ORTHOPTERA, ACRIDIDAE, CYRTACANTHACRIDINAE)

THE DIATOMS OF LINSLEY POND, CONNECTICUT [1]

BY RUTH PATRICK

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During the last several years, Linsley Pond, which is located in the head waters of Branford River in North Branford, near New Haven, Connecticut, has been the subject of much limnological research. It is a eutrophic lake, about 25 acres in area and 48 feet deep, occupying a kettle in a mass of stratified drift at 85 feet (Deevey, 1939).

The history of the development of the lake, as well as its present condition, have been studied mainly through analysis of the sediments found in four profiles which are designated as L-10, L-9, L-1A, and L-2. L-10 is located under 42 feet (13 meters) of water and penetrates to a depth of 43 feet. L-9 is located under 19 feet (6 meters) of water and penetrates to a depth of 31 feet. L-1A is located on the margin of the lake and penetrates to a depth of 15 feet. L-2 is just off shore from one of the two inlets and L-1A; it is located in 13 feet (4 meters) of water and penetrates to a depth of 26 feet.

Deevey (1939), by means of pollen analysis, finds that the developmental history of the vegetation surrounding the lake divides itself into six stages, which follow each other in succession. The lowest stage, which is designated as A_1, is characterized as a coniferous period. There is a predominance of pine; spruce and fir tend to increase. This period is followed by A_2, in which the spruce and fir reach their maximum and decline. In the next period, B_1, pine reaches its maximum and declines. In C_1 oak reaches a maximum and declines. The oak maximum is closely associated with, or preceded by, hemlock maximum. In C_2 the oak and hemlock decline while hickory rises in importance. In C_3 oak remains approximately constant, hickory declines, and chestnut and hemlock increase.

Hutchinson and Wollack (1940), by means of chemical analysis of the sediments of L-10, have shown several facts as to the development of organic sediments. Their studies would indicate that organic production

[1] The author wishes to express her appreciation to Dr. G. E. Hutchinson and Dr. E. S. Deevey, Jr., who made this study possible. The author also wishes to express her appreciation to Dr. Thomas S. Stewart who made the photographs, and to the library of the Academy of Natural Sciences of Philadelphia, to the library of the American Philosophical Society, to Miss Rosalie Weikert, New York Botanical Garden, and Miss Hilda Harris, Librarian of the Farlow Herbarium, for assistance during the preparation of this manuscript.

in the lake first occurred slowly, then increased rapidly and finally reached a period of equilibrium which was maintained for some time. This change from oligotrophic to eutrophic conditions occurred rather rapidly. The period of greatest deposition of organic matter was reached at 30 feet.

In order to understand the biocoenosis of Linsley Pond, it is necessary to study the fossil remains of the plants, other than pollen, and animals that lived in the lake. Studies have been made of the remains of insect larvae, sponges, Bryozoa, and Cladocera (Deevey, 1941). It was thought that a study of the diatoms might tell something of the plankton and littoral vegetation of the lake, as well as some facts concerning the ecological conditions.

Some species of diatoms are specific for certain ecological conditions. For instance, some are typically found in cold water, while others are found only in warm temperate water. Many species, however, seem to be more or less indifferent to temperature. Certain species are indicative of the pH of the water, being characteristically found in acid or alkaline waters. Others are indicative of the abundance or lack of various elements such as calcium, iron, chloride, etc.(Kolbe, 1932; Schroeder, 1939). Diatoms also may be indicative of water depth; some species are usually found in shallow or littoral zones and may be epiphytic, while others are planktonic forms. Some are specific for running, or for stagnant water. Recently Hustedt (1930) and others have shown that certain species are characteristic of eutrophic localities. Of course one must keep in mind the fact that in diatoms as well as in other groups of plants there are many weed species that survive under varying conditions, but associated with these are the indicative ones.

In this investigation portions of the various levels of the profiles L-10, L-9, L-1A, and L-2 were studied. In the preparation of the diatoms great care was taken that contamination did not occur. This is a very important consideration and must be carefully guarded against in such studies as these. No two samples were cleaned in the same beaker and a new pipette was used for each sample. All materials involved in the process of cleaning were carefully labelled and cleaned so that no mistake could be made. The diatoms were cleaned by the acid method except in the case of recent plankton. In these studies burned mounts were also made in order to preserve the more delicate forms which might otherwise be lost. In a few cases it was necessary to use both nitric acid and sulphuric acid, though usually nitric acid plus potassium bichromate was sufficient. The diatoms were mounted in hyrax. Specimens of each species identified were ringed by means of a diamond marker so that identification could be verified.

In the following taxonomic consideration the distribution of the species in the various layers is given by the citation of the slides on which they

were determined. These slides are in the herbarium of the Academy of Natural Sciences of Philadelphia. The number following the letter A in each citation is the number of the slide in the herbarium. Since this study was made mainly from the limnological aspect, in L-9 and L-1A, only those species were included which formed at one time or another a definite element in the flora. That is to say, sufficient shells were found to indicate that the species actually lived in the lake and was not a contamination brought in by birds, wind, or other means. However, in L-10, the profile which has been best studied, the records of species of scarce occurrence in more than one layer are included. A discussion of these methods of study will be included at the end of the paper.

There is evidence from this study that many species, though they probably lived in the lake, never occurred in such abundance as to warrant consideration of them as important species at any level. Of course it may be that owing to some very local condition they may have occurred much more numerously in some part of the lake not bisected by the profile. But at best these studies can only interpret the conditions which existed in the region of the profile.

In the citation of the species names and authorities, the original literature has been carefully checked. Dr. Deevey collected all the material for this study except where otherwise noted.

Centrales

COSCINODISCACEAE

CYCLOTELLA (Kützing) Brébisson

Cyclotella compta var. radiosa Grunow apud Van Heurck

Cyclotella compta var. *radiosa* Grunow apud Van Heurck, 1882, Syn. Diat. Belgique, pl. 92, fig. 23, also in text (1885) p. 214.

This variety is well distributed throughout all the profiles. It seems to be most abundant in the early sediments of the lake.

Linsley Pond: L-1A, 15 ft. (A-1620), 13 ft. – 7 ft. (A-1625-1639); L-10, 40 ft. – 8 ft. (A-1657-1681), 4 ft. (A-1683), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1686-1687); L-9, 24 ft. – 20 ft. (A-1691-1695), 18 ft. – 17 ft. (A-1696-1697), 10 ft. (A-1701), 8 ft. (A-1702), 4 ft. (A-1704); L-2, 16 ft. – 14 ft. (A-1712-1714), 12 ft. (A-1716); recent core in 9.5 m. water Hutchinson (A-1721, 1723).

Cyclotella glomerata Bachman

Cyclotella glomerata Bachman, 1911, Das Phytoplankton des Süsswassers, p. 131, figs. 106-108.

Linsley Pond: L-10, 28 ft. (A-1666); plankton May 1938 Riley (A-1596).

Cyclotella ocellata Pantoscek

Cyclotella ocellata Pantoscek, 1902, Resultate der Wissenschaften Erforschung des Balatonsees, vol. 2, part 2, section 1, p. 104, pl. 15, fig. 318.

This species is found most frequently in L-10 in the earlier sediments of the lake.

Linsley Pond: L-1A, 9 ft. (A-1635); L-10, 40 ft. – 32 ft. (A-1657-1663), 28 ft. (A-1666), recent core Deevey and Hutchinson (A-1686).

Cyclotella operculata (Ag.) Brébisson

Cyclotella operculata (Ag.) Brébisson, 1838, Consid. sur les Diat., p. 20. (This reference has been verified for me by Miss Hilda Harris, librarian of the Farlow Herbarium.)

Frustulia operculata Agardh, 1827, Flora, 1827, p. 627.

This species is found chiefly in L-10. Its best development is in some of the sediments which accumulated since the lake became eutrophic.

Linsley Pond: L-10, 34 ft. – 32 ft. (A-1662-1663), 28 ft. – 3 ft. (A-1666-1684), recent core Deevey and Hutchinson (A-1686-1688); plankton May 1938 Riley (A-1596); L-9, 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1707, 1708); recent core in 9.5 m. water Hutchinson (A-1721, 1723, 1725).

Cyclotella stelligera (Cl. and Grun.) Van Heurck

Cyclotella stelligera (Cl. and Grun.) Van Heurck, 1882, Syn. Diat. Belgique, pl. 94, figs. 22-27.

Cyclotella Meneghiniana var. ? *stelligera* Cleve and Grunow apud Cleve, 1881, Sv. Vet. Akad. Handl., vol. 18, no. 5, p. 22.

Linsley Pond: L-10, 32 ft. (A-1663), 28 ft. – 3 ft. (A-1666-1684), recent core Deevey and Hutchinson (A-1686-1688); plankton May 1938 Riley (A-1596).

MELOSIRA Agardh

Melosira ambigua (Grun.) Müller

Melosira ambigua (Grun.) Müller, 1905, Bot. Jahrb. Syst. Pflanzengesch. u. Pflanzengeog., vol. 34, p. 283, pl. 4, figs. 9, 10.

For a discussion of this species see my paper, Proc. Acad. Nat. Sci. Phila., vol. 92, p. 195. It is typically a plankton form which reaches its best development in eutrophic conditions. The larger forms of the species are encountered in the early sediments of L-10. However, it is not until the 24 ft. level of L-10 that the narrow form reaches its best development. Indeed it is one of the dominant species, if not the dominant one, from the 24 ft. level up to the middle of the recent core taken by Deevey and Hutchinson. Conditions must have been ideal for the development of *M. ambigua*, for it is very abundant.

Linsley Pond: L-10, 40 ft. (A-1657), 38 ft. (A-1658), 34 ft. (A-1662), 32 ft. (A-1663), 28 ft. – 3 ft. (A-1666-1684), recent core Deevey and Hutchinson (A-1686-1688), plankton January 1938 Riley (A-1597); L-9, 4 ft. (A-1704), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1707-1708); recent core in 9.5 m. water Hutchinson (A-1721, 1722, 1725).

Melosira italica (Ehr.) Kützing

Melosira italica (Ehr.) Kützing, 1844, Bacill., p. 55, pl. 2, fig. 6.
Gaillonella italica Ehrenberg, 1836, Berichte Akad. Wiss. Berlin, 1836, p. 53.

Linsley Pond: plankton May 1938 Riley (A-1596), plankton January 1938 Riley (A-1597).

Melosira italica var. **tenuis** (Kütz.) Müller

Melosira italica var. *tenuis* (Kütz.) Müller, 1905, Bot. Jahrb. Syst. Pflanzengesch. u. Pflanzengeog., vol. 34, p. 265.
Melosira tenuis Kützing, 1844, Bacill., p. 54, pl. 3, fig. 2.

Linsley Pond: plankton January 1938 Riley (A-1597).

STEPHANODISCUS Ehrenberg

Stephanodiscus astraea (Ehr.) Grunow apud Cleve and Grunow

Stephanodiscus astraea (Ehr.) Grunow apud Cleve and Grunow, 1880, Sv. Vet. Akad. Handl., vol. 17, no. 2, p. 114.
Discoplea (?) *astraea* Ehr. ex Kützing, 1849, Spec. Algarum, p. 19.

I have not been able to find Ehrenberg's published description of this species, which Ehrenberg also seems to have described in 1844 under the name *Discoplea* (?) *rotula* Ehr. (Berichte Akad. der Wissenschaften, 1844, p. 202). Though *D. rotula* is regarded as a synonym by later workers, unless the earlier description of *D. astraea* is found, *rotula* may be the correct species name.

The variety *minutula* of this species is often recognized. Although some of my specimens agree with some of the published figures of this variety, they are not the same as specimens determined by Grunow on Cleve and Moeller slide Nos. 221, 264. In my specimens, which are of the same size range, the markings are finer, the central field is more like that of the species, and all the specimens seem to bear spines, though in some cases they are difficult to distinguish. For these reasons I am considering the present material under the species name rather than that of the variety.

S. astraea is a plankton form which is usually found in eutrophic conditions. In Linsley Pond it reaches its best development in L-10 after the lake becomes eutrophic.

Linsley Pond: L-10, 32-3 ft. (A-1663-1684), recent core Deevey and Hutchinson (A-1686-1688), plankton January 1938 Riley (A-1597); L-9, recent core Deevey and Hutchinson (A-1707, 1708).

SOLENIACEAE

RHIZOSOLENIA Ehrenberg

Rhizosolenia eriensis H. L. Smith

Rhizosolenia eriensis H. L. Smith, 1872, The Lens, vol. 1, p. 44.

Linsley Pond: plankton May 1938 Riley (A-1596).

PENNALES

FRAGILARIACEAE

TABELLARIA Ehrenberg

Tabellaria fenestrata (Lyngb.) Kützing

Tabellaria fenestrata (Lyngb.) Kützing, 1844, Bacill., p. 127, pl. 17, fig. 22, pl. 18, fig. 2, pl. 30, fig. 73.

Diatoma fenestratum Lyngbye, 1819, Tent. Hydrophyt. Danicae, p. 180, pl. 61, fig. 3.

Hustedt (1930) states that this species is a littoral or pelagic form. It is found in all kinds of water, but is preponderant in eutrophic localities.

Linsley Pond: L-1A, 13 ft. (A-1625), 11 ft. (A-1630), 9 ft. – 7 ft. (A-1635-1639), 3 ft. (A-1644), 1 ft. (A-1649); L-10, 36 ft. – 32 ft. (A-1661-1663), 28 ft. – 26 ft. (A-1666-1668), 22 ft. – 20 ft. (A-1670-1671), 15 ft. – 12 ft. (A-1675-1678), 9 ft. (A-1680), 4 ft. – 3 ft. (A-1683-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, recent core Deevey and Hutchinson (A-1706, 1707); L-2, 14 ft. (A-1714), 13 ft. (A-1715), 12 ft. (A-1716); recent core in 9.5 m. water Hutchinson (A-1723, 1725).

ODONTIDIUM Kützing emend. Bessey

Odontidium hyemale (Lyngb.) Kützing

Odontidium hyemale (Lyngb.) Kützing, 1844, Bacill., p. 44, pl. 17, fig. 4.

Fragilaria hyemale Lyngbye, 1819, Tent. Hydrophyt. Danicae, p. 185.

Linsley Pond: L-9, 21 ft. (A-1694).

MERIDION Agardh

Meridion circulare (Grev.) Agardh

Meridion circulare (Grev.) Agardh, 1831, Consp. Crit. Diat., p. 40.

Echinella circulare Greville, 1822, Memoirs Wern. Nat. Hist. Soc., vol. 4, part 1, pp. 213-215, pl. 8, fig. 2.

This species is present but not ever of frequent occurrence.

Linsley Pond: L-10, 20 ft. (A-1671), 17 ft. (A-1674), 13 ft. – 10 ft. (A-1676-1679), 8 ft. (A-1681), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1687-1688); L-9, 21 ft. – 20 ft. (A-1694-1695), recent core Deevey and Hutchinson (A-1707, 1708); recent core in 9.5 m. water Hutchinson (A-1721).

OPEPHORA Petit

Opephora Martyi Heribaud

Opephora Martyi Heribaud, 1902, Foss. Diat. Auvergne, p. 43, pl. 8, fig. 20.

This species is most often found in eutrophic water. In Linsley Pond it is found in certain levels of all the profiles.

Linsley Pond: L-1A, 13 ft. – 12 ft. (A-1625-1629), 10 ft. – 4 ft. (A-1636-1643); L-10, 32 ft. – 20 ft. (A-1663-1671), 17 ft. – 12 ft. (A-1674-1678), 9 ft. – 6 ft. (A-1680-1682), recent core Deevey and Hutchinson (A-1686,

1687); L-9, 22 ft. – 2 ft. (A-1693-1705), recent core Deevey and Hutchinson (A-1707); L-2, 16 ft. – 8 ft. (A-1712-1718); recent core in 9.5 m. water Hutchinson (A-1721).

SYNEDRA Ehrenberg

Synedra acus Kützing

Synedra acus Kützing, 1844, Bacill., p. 68, pl. 15, fig. 7.

Linsley Pond: L-10, recent core Deevey and Hutchinson (A-1688).

Synedra acus var. **angustissima** (Grun.) Van Heurck

Synedra acus var. *angustissima* (Grun.) Van Heurck, 1885, Syn. Diat. Belgique, p. 151.
Synedra delicatissima var. *angustissima* Grunow apud Van Heurck, 1881, Syn. Diat. Belgique, pl. 39, fig. 10.

This is typically a plankton form. It is often found in eutrophic water.

Linsley Pond: L-10, 22 ft. – 20 ft. (A-1670-1671), recent core Deevey and Hutchinson (A-1688), plankton January 1938 Riley (A-1597), plankton May 1938 Riley (A-1596); L-9, recent core Deevey and Hutchinson (A-1708); recent core in 9.5 m. water Hutchinson (A-1725).

Synedra amphicephala Kützing

Synedra amphicephala Kützing, 1844, Bacill., p. 64, pl. 3, fig. 12.

This is a littoral species.

Linsley Pond: L-1A, 9 ft. (A-1635), 8 ft. (A-1637), 6 ft. (A-1640), 3 ft. (A-1644), shallow water November 1941 Patrick (A-1652); L-10, 38 ft. – 32 ft. (A-1658-1663), 28 ft. – 24 ft. (A-1666-1669), 20 ft. – 19 ft. (A-1671-1673), 15 ft. – 13 ft. (A-1675-1676), 6 ft. (A-1682), recent core Deevey and Hutchinson (A-1688); L-9, recent core Deevey and Hutchinson (A-1707).

Synedra biceps Kützing

Synedra biceps Kützing, 1884, Bacill., p. 66, pl. 14, figs. 18, 21.

This species is present but at no time abundant.

Linsley Pond: L-10, 20 ft. (A-1671), 19 ft. (A-1672).

Synedra capitata Ehrenberg

Synedra capitata Ehrenberg, 1836, Poggendorff's Ann. Phys., 1836, pl. 3, fig. 3.

According to Hustedt this is usually a littoral form. Though it is present in several levels of the profile of L-10, it is never abundant.

Linsley Pond: L-10, 34 ft. (A-1662), 24 ft. – 19 ft. (A-1669-1673), 12 ft. (A-1678), 9 ft. (A-1680), 6 ft. (A-1682), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1688); L-9, recent core Deevey and Hutchinson (A-1708); recent core in 9.5 m. water Hutchinson (A-1723).

Synedra minuscula Grunow apud Van Heurck

Synedra minuscula Grunow apud Van Heurck, 1881, Syn. Diat. Belgique, pl. 39, fig. 13.

Linsley Pond: plankton May 1938 Riley (A-1596).

Synedra radians Kützing

Synedra radians Kützing, 1844, Bacill., p. 64, pl. 14, fig. VII, 1-4.

Linsley Pond: L-10, 24 ft. (A-1669), plankton May 1938 Riley (A-1596).

Synedra ulna (Nitzsch) Ehrenberg

Synedra ulna (Nitzsch) Ehrenberg, 1832, Abhandl. Akad. Wiss. Berlin, 1831, p. 87.
Bacillaria ulna Nitzsch, 1817, N. Schrift. Naturf. Ges. Halle, vol. 3, heft 1, p. 99.

Linsley Pond: L-10, 24 ft. (A-1669), recent core Deevey and Hutchinson (A-1688), plankton May 1938 Riley (A-1596).

Synedra ulna var. **danica** (Kütz.) Van Heurck

Synedra ulna var. *danica* (Kütz.) Van Heurck, 1881, Syn. Diat. Belgique, pl. 38, fig. 14a, text (1885) p. 151.
Synedra danica Kützing, 1844, Bacill., p. 66, pl. 14, fig. 13.

This is typically a plankton form. It is only once of even frequent occurrence in Linsley Pond.

Linsley Pond: L-10, 26 ft. – 20 ft. (A-1668-1671), 13 ft. – 12 ft. (A-1676-1678), 9 ft. (A-1680), 4 ft. – 3 ft. (A-1683-1684), recent core Deevey and Hutchinson (A-1688); L-9, recent core Deevey and Hutchinson (A-1707, 1708).

Synedra ulna var. **longissima** (W. Sm.) Brun

Synedra ulna var. *longissima* (W. Sm.) Brun, 1880, Diatomees des Alpes et du Jura, p. 126, pl. 4, fig. 21.
Synedra longissima W. Smith, 1853, Brit. Diat., vol. 1, p. 72, pl 12, fig. 95.

This variety is not of frequent occurrence at any level.

Linsley Pond: L-10, 24 ft. (A-1669), 22 ft. (A-1670), 13 ft. (A-1676); L-9, recent core Deevey and Hutchinson (A-1707).

Synedra ulna var. **subaequalis** Grunow apud Van Heurck

Synedra ulna var. *subaequalis* Grunow apud Van Heurck, 1881, Syn. Diat. Belgique, pl. 38, fig. 13, text (1885) p. 151.

This variety is not of frequent occurrence at any level until the recent core.

Linsley Pond: L-1A, shallow water November 1941 Patrick (A-1652); L-10, 22 ft. (A-1670), 4 ft. (A-1683), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1688); plankton May 1938 Riley (A-1596); L-9, recent core Deevey and Hutchinson (A-1707, 1708).

FRAGILARIA Lyngbye emend. Rabenhorst

Fragilaria brevistriata Grunow apud Van Heurck

Fragilaria brevistriata Grunow apud Van Heurck, 1881, Syn. Diat. Belgique, pl. 45, fig. 32, text (1885) p. 157.

This species is most abundant in the earlier sediments of the lake. Its best development is in L-9 and L-1A.

Linsley Pond: L-1A, 15 ft. – 6 ft. (A-1620-1641); L-10, 40 ft. – 36 ft. (A-1657-1661), 32 ft. – 20 ft. (A-1663-1671), 17 ft. – 12 ft. (A-1674-1678),

9 ft. (A-1680); L-9, 25 ft. – 21 ft. (A-1690-1694), 18 ft. – 9 ft. (A-1696-1701b), 4 ft. (A-1704), 2 ft. (A-1705); L-2, 14 ft. (A-1714), 12 ft. (A-1716), 10 ft. (A-1717), 8 ft. (A-1718), 6 ft. (A-1719); recent core in 9.5 m. water Hutchinson (A-1721).

Fragilaria capucina var. **mesolepta** Rabenhorst

Fragilaria capucina var. *mesolepta* Rabenhorst, 1864, Flora Europaea Algarum, p. 118.

Linsley Pond: L-10, recent core Deevey and Hutchinson (A-1688).

Fragilaria construens (Ehr.) Grunow

Fragilaria construens (Ehr.) Grunow, 1862, Verh. Zool. Bot. Ges. Wien, vol. 12, p. 371, pl. 7, fig. 10.

Staurosira construens Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, p. 424.

This species is most abundant in the early sediments of the lake. It is usually considered a littoral form, but may be found in plankton.

Linsley Pond: L-1A, 15 ft. – 5 ft. (A-1620-1642), 1 ft. (A-1650); L-10, 40 ft. – 3 ft. (A-1657-1684), recent core Deevey and Hutchinson (A-1686, 1687); L-9, 25 ft. – 20 ft. (A-1690-1695), 18 ft. – 2 ft. (A-1696-1705), recent core Deevey and Hutchinson (A-1706-1708); L-2, 17 ft. – 8 ft. (A-1711-1718); recent core in 9.5 m. water Hutchinson (A-1721, 1723, 1725).

Fragilaria construens var. **binodis** (Ehr.) Grunow

Fragilaria construens var. *binodis* (Ehr.) Grunow, 1862, Verh. Zool. Bot. Ges. Wien, vol. 12, p. 371.

Fragilaria binodis Ehrenberg, 1854, Mikrogeologie, pl. 16, fig. II, 26.

This variety is usually a littoral form.

Linsley Pond: L-1A, 15 ft. (A-1620), 13 ft. – 11 ft. (A-1625-1632), 7 ft. (A-1639); L-10, 36 ft. – 34 ft. (A-1660-1662), 22 ft. (A-1670), 13 ft. (A-1676), recent core Deevey and Hutchinson (A-1686); L-9, 20 ft. (A-1695), 17 ft. (A-1697), 4 ft. (A-1704); L-2, 14 ft. (A-1714), 13 ft. (A-1715); recent core in 9.5 m. water Hutchinson (A-1721).

Fragilaria crotonensis Kitton

Fragilaria crotonensis Kitton, 1869, Science Gossip, 1869, p. 110, fig. 81.

Edwards sent the material to Kitton but seems to have had nothing to do with the identification of the species.

F. crotonensis, though present in the past history of the lake, never was a dominent part of the flora till fairly recent times. To-day it is one of the dominant plankton forms.

This species is characteristic of eutrophic plankton. Hustedt (1930) states it reaches its best development in north German lakes in the height of summer.

Linsley Pond: L-10, 34 ft. (A-1662), 20 ft. – 19 ft. (A-1671-1673), 10 ft. – 6 ft. (A-1679-1682), recent core Deevey and Hutchinson (A-1686-1688), plankton January 1938 Riley (A-1597), plankton May 1938 Riley

(A-1596); L-9, recent core Deevey and Hutchinson (A-1708); recent core in 9.5 m. water Hutchinson (A-1725).

Fragilaria lapponica Grunow apud Van Heurck

Fragilaria lapponica Grunow apud Van Heurck, 1881, Syn. Diat. Belgique, pl. 45, fig. 35.

This species is present in the early sediments of L-1A and L-9.

Linsley Pond: L-1A, 13 ft. – 11 ft. (A-1625-1632); L-9, 24 ft. – 21 ft. (A-1691-1694).

Fragilaria leptostauron (Ehr.) Hustedt

Fragilaria leptostauron (Ehr.) Hustedt, 1931, in Rabenhorst's Kryptogamen-Flora, vol. 7, Die Kieselalgen, part 2, p. 153, fig. 668 a-f.

Biblarium leptostauron Ehrenberg, 1854, Mikrogeologie, pl. 5, fig. II, 24; pl. 12, figs. 35, 36.

This is typically a littoral form.

Linsley Pond: L-1A, 15 ft. (A-1620), 13 ft. (A-1625), 12 ft. (A-1628); L-10, 40 ft. – 34 ft. (A-1657-1662), 17 ft. (A-1674), 13 ft. (A-1676), 10 ft. (A-1679), 8 ft. (A-1681), recent core Deevey and Hutchinson (A-1688); L-9, 25 ft. (A-1690), 23 ft. – 20 ft. (A-1692-1695); L-2, 16 ft. – 14 ft. (A-1712-1714); recent core in 9.5 m. water Hutchinson (A-1721, 1724).

Fragilaria parasitica (W. Sm.) Grunow

Fragilaria parasitica (W. Sm.) Grunow, 1881, apud Van Heurck, Syn. Diat. Belgique, pl. 45, fig. 30.

Odontidium parasitica W. Smith, 1856, Brit. Diat., vol. 2, p. 19, pl. 60, fig. 375.

Linsley Pond: L-10, 34 ft. (A-1662), 28 ft. – 26 ft. (A-1666-1668), 17 ft. – 12 ft. (A-1674-1678), 8 ft. (A-1681), 4 ft. – 3 ft. (A-1683-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, recent core Deevey and Hutchinson (A-1707); L-2, 8 ft. (A-1718); recent core in 9.5 m. water Hutchinson (A-1721, 1723).

Fragilaria pinnata Ehrenberg

Fragilaria pinnata Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, p. 415.

It is difficult to be sure if Ehrenberg's description and his figures in the *Mikrogeologie* refer to the species, to which we to-day give this name.

This species is most abundant in the earlier sediments of the lake.

Linsley Pond: L-1A, 15 ft. – 12 ft. (A-1620-1629), 10 ft. – 8 ft. (A-1633-1638); L-10, 40 ft. (A-1657), 36 ft. – 34 ft. (A-1660-1662), 30 ft. (A-1664), 26 ft. (A-1668), 22 ft. – 20 ft. (A-1670-1671), 17 ft. – 3 ft. (A-1674-1684), recent core Deevey and Htuchinson (A-1686, 1687); L-9, 25 ft. – 20 ft. (A-1690-1695), 17 ft. (A-1697), 16 ft. (A-1698), 9 ft. (A-1701b), 4 ft. (A-1704), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1706); recent core in 9.5 m. water Hutchinson (A-1721, 1723).

Fragilaria Vaucheriae (Kütz.) Boye

Fragilaria Vaucheriae (Kütz.) Boye, 1938, Bot. Not., 1938, heft 1-3, p. 164-171.

Exilaria Vaucheriae Kützing, 1833, Linnaea, vol. 8, p. 560, pl. 15, fig. 38; Kützing Dec. No. 24.

This species, which is usually a littoral form, is most numerous in L-1A and L-10.

Linsley Pond: L-1A, 13 ft. (A-1625), 10 ft. (A-1633), 9 ft. (A-1635), 7 ft. (A-1639), 3 ft. (A-1644), shallow water November 1941 Patrick (A-1652); L-10, 36 ft. (A-1660), 32 ft. (A-1663), 28 ft. – 19 ft. (A-1666-1673), 15 ft. – 12 ft. (A-1675-1678), 9 ft. – 6 ft. (A-1680-1682), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, 12 ft. (A-1700), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1708); recent core in 9.5 m. water Hutchinson (A-1721).

Fragilaria virescens Ralfs

Fragilaria virescens Ralfs, 1843, Ann. and Mag. Nat. Hist., vol. 12, pl. 2, fig. 6, p. 110.

Linsley Pond: L-1A, 13 ft. (A-1625); L-10, 12 ft. (A-1678).

ASTERIONELLA Hassall

Asterionella formosa Hassall

Asterionella formosa Hassall, 1855, Microscopical Examination of Water, p. 10. (I was not able to check this reference.)

Linsley Pond: L-10, 24 ft. (A-1669), 22 ft. (A-1670), recent core Deevey and Hutchinson (A-1686-1688), plankton January 1938 Riley (A-1597), plankton May 1938 Riley (A-1596); L-9, recent core Deevey and Hutchinson (A-1708); recent core in 9.5 m. water Hutchinson (A-1725).

EUNOTIACEAE

EUNOTIA Ehrenberg

Eunotia arcus Ehrenberg

Eunotia arcus Ehrenberg, 1837, Berichte Akad. Wiss. Berlin, 1837, p. 45.

This is one of the few calciophil species of the genus *Eunotia*.

Linsley Pond: L-1A, 11 ft. – 8 ft. (A-1630-1638), 4 ft. (A-1643), shallow water November 1941 Patrick (A-1652); L-10, 36 ft. – 26 ft. (A-1660-1668), 22 ft. – 19 ft. (A-1670-1673), 15 ft. – 12 ft. (A-1675-1678), recent core Deevey and Hutchinson (A-1688); L-9, 12 ft. – 8 ft. (A-1700-1702); L-2, 14 ft. (A-1714), 8 ft. (A-1718), 6 ft. (A-1719).

Eunotia arcus var. **bidens** Grunow apud Van Heurck

Eunotia arcus var. *bidens* Grunow apud Van Heurck, 1881, Syn. Diat. Belgique, pl. 34, fig. 7.

Linsley Pond: L-10, 32 ft. (A-1663), 13 ft. (A-1676), 9 ft. (A-1680).

Eunotia arcus var. **fallax** Hustedt apud Pascher

Eunotia arcus var. *fallax* Hustedt apud Pascher, 1930, Süsswasser-Flora Mitteleuropas, heft 10, Bacill., p. 175, fig. 219.

This variety is also found in the presence of lime.

Linsley Pond: L-1A, 9 ft. (A-1635); L-10, 38 ft. (A-1658), 28 ft. (A-1666), 22 ft. (A-1670), 19 ft. (A-1672), 15 ft. – 13 ft. (A-1675-1676), 10 ft. (A-1679).

Eunotia diodon Ehrenberg

Eunotia diodon Ehrenberg, 1837, Berichte Akad. Wiss. Berlin, 1837, p. 45.

Hustedt (1930) states that this species is very abundant only in mountainous regions.

It is present but not abundant in the sediments of L-1A, L-10, and L-2.

Linsley Pond: L-1A, 13 ft. – 6 ft. (A-1625-1641); L-10, 38 ft. (A-1658), 34 ft. – 32 ft. (A-1662-1663), 26 ft. (A-1668), 22 ft. – 20 ft. (A-1670-1671), 15 ft. – 13 ft. (A-1675-1676); L-2, 16 ft. (A-1712).

Eunotia flexuosa (Bréb.) Kützing

Eunotia flexuosa (Bréb.) Kützing, 1849, Species Algarum, p. 6.

Kützing states that Brebisson named this species *Synedra ? flexuosa.* I have not been able to verify this reference.

This species was only encountered once and then it was merely present.

Linsley Pond: L-10, 9 ft. (A-1680).

Eunotia formica Ehrenberg

Eunotia formica Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, p. 414.

This species is often found in still water. It is quite commonly encountered in recent fossil deposits in New England.

It is well distributed through all the profiles but never forms a very important part of the flora.

Linsley Pond: L-1A, 13 ft. (A-1625), 11 ft. (A-1630), 10 ft. (A-1633), 6 ft. (A-1640), 5 ft. (A-1642), 3 ft. (A-1644), 1 ft. (A-1648); L-10, 34 ft. (A-1662), 30 ft. – 20 ft. (A-1664-1671), 17 ft. – 3 ft. (A-1674-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, 16 ft. – 2 ft. (A-1698-1705), recent core Deevey and Hutchinson (A-1706-1708); L-2, 16 ft. – 6 ft. (A-1712-1719); recent core in 9.5 m. water Hutchinson (A-1721, 1724, 1725).

Eunotia gracilis (Ehr.) Rabenhorst

Eunotia gracilis (Ehr.) Rabenhorst, 1864, Flora Europaea Algarum, p. 72.

Himantidium gracile Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, p. 417, pl. 2 fig. I, 9, pl. 3, fig. I, 41.

Linsley Pond: L-10, 38 ft. (A-1658), 34 ft. – 32 ft. (A-1662-1663), 28 ft. – 20 ft. (A-1666-1671), 10 ft. (A-1679), 6 ft. (A-1682); L-9, 12 ft. (A-1700).

Eunotia lunaris (Ehr.) Grunow apud Van Heurck

Eunotia lunaris (Ehr.) Grunow apud Van Heurck, 1881, Syn. Diat. Belgique, pl. 35, figs. 3, 4, 6.

Synedra lunaris Ehrenberg, 1832. Abhandl. Akad. Wiss. Berlin, 1831, p. 87.

This species is not abundant at any level. It is found most often in the L-10 profile.

Linsley Pond: L-1A, 3 ft. (A-1644); L-10, 34 ft. – 32 ft. (A-1662-1663), 28 ft.–20 ft. (A-1666-1671), 15 ft.–3 ft. (A-1675-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, 2 ft. (A-1705), recent core Deevey and

Hutchinson (A-1706-1708); recent core in 9.5 m. water Hutchinson (A-1724, 1725).

Eunotia monodon Ehrenberg

Eunotia monodon Ehrenberg, 1854, Mikrogeologie, pl. 2, fig. II, 26 a, b.

This species is usually found in cool temperate water.

Linsley Pond: L-1A, 1 ft. (A-1648); L-10, 15 ft. – 6 ft. (A-1675-1682); L-9, 8 ft. – 2 ft. (A-1702-1705); L-2, 6 ft. (A-1719).

Eunotia monodon var. **maior** (W. Sm.) Hustedt apud A. Pascher

Eunotia monodon var. *maior* (W. Sm.) Hustedt apud A. Pascher, 1930, Süsswasser-Flora Mitteleuropas, heft 10, Bacill., p. 186.

Himantidium maior W. Smith, 1856, Brit. Diat., vol. 2, p. 14, pl. 33, fig. 286.

Not numerous at any level.

Linsley Pond: L-1A, 1 ft. (A-1648); L-10, 28 ft. (A-1666), 24 ft. – 22 ft. (A-1669-1670), 17 ft. (A-1674), 13 ft. (A-1676), 10 ft. – 3 ft. (A-1679-1684), recent core Deevey and Hutchinson (A-1686, 1687); L-9, recent core Deevey and Hutchinson (A-1706); L-2, 16 ft. (A-1712); recent core in 9.5 m. water Hutchinson (A-1723).

Eunotia pectinalis (Dillwyn) Rabenhorst

Eunotia pectinalis (Dillwyn) Rabenhorst, 1864, Flora Europaea Algarum, p. 73.

Conferva pectinalis Dillwyn, 1809, Brit. Conf., p. 43, pl. 24.

Sometimes Ralfs is given credit for the species name and the authority of Dillwyn is questioned. Since Ralfs (1843, Ann. Mag. Nat. Hist., 12, p. 107) states his specimen, which he calls *Fragilaria pectinalis*, is the same as Dillwyn's *Conferva pectinalis*, I see no reason to continue the questionability of the citation of Dillwyn.

This species is of infrequent occurrence in Linsley Pond.

Linsley Pond: L-10, 15 ft. – 10 ft. (A-1675-1679), 8 ft. (A-1681), 4 ft. (A-1683); L-9, 10 ft. (A-1701).

Eunotia pectinalis var. **minor** (Kütz.) Rabenhorst

Eunotia pectinalis var. *minor* (Kütz.) Rabenhorst, 1864, Flora Europaea Algarum, p. 74.

Himantidium minus Kützing, 1844, Bacill., p. 39, pl. 16, fig. 10, 1-4.

Though present in several levels, it is abundant in none.

Linsley Pond: L-1A, 13 ft. – 12 ft. (A-1625-1629), 1 ft. (A-1648); L-10, 28 ft.–24 ft. (A-1666-1669), 15 ft.–9 ft. (A-1675-1680), recent core Deevey and Hutchinson (A-1686-1688); plankton May 1938 Riley (A-1596); L-9, 12 ft. (A-1700), recent core Deevey and Hutchinson (A-1706); recent core in 9.5 m. water Hutchinson (A-1721, 1725).

Eunotia pectinalis var. **minor** f. **impressa** (Ehr.) Hustedt

Eunotia pectinalis var. *minor* f. *impressa* (Ehr.) Hustedt, 1930, apud A. Pascher, Süsswasser-Flora Mitteleuropas, heft 10, Bacill., p. 182.

Eunotia impressa Ehrenberg, 1854, Mikrogeologie, pl. 14, fig. 66, pl. 3, fig. IV, 20.

Though this form is found in all the profiles it is not frequent at any level.

Linsley Pond: L-1A, 9 ft. (A-1635), 3 ft. (A-1644), shallow water November 1941 Patrick (A-1652); L-10, 36 ft. (A-1660), 32 ft. (A-1663), 24 ft. (A-1669), 20 ft. – 4 ft. (A-1671-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, 22 ft. (A-1693), 14 ft. (A-1699), 6 ft. – 2 ft. (A-1703-1705), recent core Deevey and Hutchinson (A-1706-1708); L-2, 8 ft. (A-1718); recent core in 9.5 m. water Hutchinson (A-1724).

Eunotia pectinalis var. **ventralis** (Ehr.) Hustedt

Eunotia pectinalis var. *ventralis* (Ehr.) Hustedt, 1911, Abhandl. Naturw. Ver. Bremen, vol. 20, p. 276, pl. 3, figs. 26, 27.

Eunotia ventralis Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, p. 414.

Linsley Pond: L-10, 20 ft. (A-1671), 17 ft. – 3 ft. (A-1674-1684).

Eunotia praerupta Ehrenberg

Eunotia praerupta Ehrenberg, 1841, Berichte Akad. Wiss. Berlin, 1841, pp. 143, 204.

However, this is not the original description. There is evidently an older reference which I have not been able to locate. On page 143 it is listed as one of 73 characteristic American organisms.

This species is typically found in cool water. It also is tolerant of calcium as contrasted with most species of *Eunotia*.

Linsley Pond: L-1A, 11 ft. (A-1630), 8 ft. (A-1637); L-10, 28 ft. (A-1667); L-2, 6 ft. (A-1719).

Eunotia veneris (Kütz.) De-Toni

Eunotia veneris (Kütz.) De-Toni, 1891, Sylloge Algarum, vol. 2, p. 794.

Himantidium veneris Kützing, 1844, Bacill., p. 40, pl. 30, fig. 7.

Linsley Pond: L-1A, 3 ft. (A-1644), 1 ft. (A-1648); L-10, 20 ft. – 3 ft. (A-1671-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, 21 ft. (A-1694), 10 ft. (A-1701), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1706-1708); recent core in 9.5 m. water Hutchinson (A-1721, 1723).

ACHNANTHACEAE

ACHNANTHES Bory

Achnanthes exigua Grunow apud Cleve and Grunow

Achnanthes exigua Grunow apud Cleve and Grunow, 1880, Sv. Vet. Akad. Handl., vol. 17, no. 2, p. 21.

This species is present in three profiles.

Linsley Pond: L-1A, 9 ft. – 6 ft. (A-1635-1641); L-10, 36 ft. (A-1660), 28 ft. (A-1666), 24 ft. – 3 ft. (A-1669-1684), recent core Deevey and Hutchinson (A-1686, 1687); L-9, 21 ft. (A-1694), 17 ft. – 12 ft. (A-1697-1700), 4 ft. (A-1704), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1706, 1707;) recent core in 9.5 m. water Hutchinson (A-1721, 1722).

Achnanthes exigua var. **heterovalvata** Krasske

Achnanthes exigua var. *heterovalvata* Krasske, 1923, Bot. Archiv., vol. 3, no. 4, p. 193, fig. 9, a, b.

Linsley Pond: L-1A, 13 ft. (A-1625), 11 ft. (A-1630).

Achnanthes lanceolata (Bréb.) Grunow apud Cleve and Grunow

Achnanthes lanceolata (Bréb.) Grunow apud Cleve and Grunow, 1880, K. Sv. Vet. Akad. Handl., vol. 17, no. 2, p. 23.

Achnanthidium lanceolatum Brébisson ex Kützing, 1849, Spec. Algarum, p. 54.

Linsley Pond: L-10, 13 ft. (A-1676), recent core Deevey and Hutchinson (A-1686), plankton May 1938 Riley (A-1596); L-9, 18 ft. (A-1696); recent core in 9.5 m. water Hutchinson (A-1723).

Achnanthes lanceolata var. **elliptica** Cleve

Achnanthes lanceolata var. *elliptica* Cleve, 1891, Acta Soc. pro Fauna et Flora Fennica, vol. 8, no. 2, p. 51, pl. 3, figs. 10-11.

Linsley Pond: L-10, 15 ft. (A-1675), 13 ft. (A-1676), 10 ft. (A-1679), 6 ft. (A-1682), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1686, 1687); L-9, 21 ft. (A-1694), 9 ft. (A-1701b), recent core Deevey and Hutchinson (A-1707, 1708).

Achnanthes lanceolata var. **rostrata** Hustedt apud Pascher

Achnanthes lanceolata var. *rostrata* Hustedt apud Pascher, 1930, Süsswasser-Flora Mitteleuropas, heft 10, p. 208, fig. 306 b.

Linsley Pond: L-2, 12 ft. (A-1716), 8 ft. (A-1718); recent core in 9.5 m. water Hutchinson (A-1723).

Achnanthes minutissima Kutzing

Achnanthes minutissima Kützing, 1844, Bacill., p. 75, pl. 13, fig. 2 c.

Linsley Pond: plankton May 1938 Riley (A-1596).

EUCOCCONEIS Cleve

Eucocconeis flexella (Kütz.) Cleve

Eucocconeis flexella (Kütz.) Cleve, 1895, Sv. Vet. Akad. Handl., vol. 27, no. 3, p. 179.

Cymbella ? flexella Kützing, 1844, Bacill., p. 80.

Linsley Pond: L-1A, 13 ft. – 7 ft. (A-1625-1639); L-10, 38 ft. – 20 ft. (A-1658-1671), 13 ft. (A-1676), recent core Deevey and Hutchinson (A-1687); L-9, 21 ft. – 18 ft. (A-1694-1696), 12 ft. (A-1700), 10 ft. (A-1701); L-2, 16 ft. – 15 ft. (A-1712-1713), 13 ft. – 12 ft. (A-1715-1716), 8 ft. (A-1718).

COCCONEIS Ehrenberg

Cocconeis placentula Ehrenberg

Cocconeis placentula Ehrenberg, 1838, Die Infusionsthierchen als Volkommene Organismen, p. 194.

This species is well distributed through all the profiles. The specimens are intermediate between the species and variety *lineata*.

Linsley Pond: L-1A, 10 ft. – 7 ft. (A-1633-1639), 1 ft. (A-1648), shallow water November 1941 Patrick (A-1652); L-10, 34 ft. – 3 ft. (A-1662-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, 20 ft. (A-1695), 16 ft. – 10 ft. (A-1698-1701), 4 ft. (A-1704), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1706-1708); L-2, 16 ft. – 8 ft. (A-1712-1718; recent core in 9.5 m. water Hutchinson (A-1721, 1724, 1725).

NAVICULACEAE

DIPLONEIS Ehrenberg

Diploneis marginestriata Hustedt

Diploneis marginestriata Hustedt, 1922, Intern. Rev. Hydrob. u. Hydrog., vol. 10, p. 236, pl. 3, fig. 5.

Linsley Pond: L-10, 12 ft. (A-1678), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1686); recent core in 9.5 m. water Hutchinson (A-1721).

Diploneis ovalis (Hilse) Cleve

Diploneis ovalis (Hilse) Cleve, 1891, Acta Soc. pro Fauna et Flora Fennica, vol. 8, no. 2, p. 44, pl. 2, fig. 13.

Pinnularia ovalis Hilse in Rabenhorst, 1861, Algen Europa, no. 1025.

This species is found in fresh to slightly salt water.

Linsley Pond: L-10, 34 ft. (A-1662), 30 ft. – 26 ft. (A-1664-1668), 22 ft. – 20 ft. (A-1670-1671), 17 ft. – 3 ft. (A-1674-1684), recent core Deevey and Hutchinson (A-1686, 1687); L-9, 2 ft. (A-1715), recent core Deevey and Hutchinson (A-1706-1708); L-2, 14 ft. (A-1714), 13 ft. (A-1715), 8 ft. (A-1718), 6 ft. (A-1719); recent core in 9.5 m. water Hutchinson (A-1721, 1723, 1725).

Diploneis Smithii (Bréb. ex W. Sm.) Cleve

Diploneis Smithii (Bréb. ex W. Sm.) Cleve, 1894, Sv. Vet. Akad. Handl., vol. 26, no. 2, p. 96.

Navicula Smithii Bréb. ex W. Smith, 1856, Brit. Diat., vol. 2, p. 92.

Linsley Pond: L-10, 26 ft. – 22 ft. (A-1668-1670), 19 ft. – 3 ft. (A-1672-1684), recent core Deevey and Hutchinson (A-1686, 1687); L-9, 14 ft. – 10 ft. (A-1699-1701), 4 ft. (A-1704), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1707); L-2, 10 ft. (A-1717), 8 ft. (A-1718).

GYROSIGMA Hassall

Gyrosigma acuminata (Kütz.) Rabenhorst

Gyrosigma acuminata (Kütz.) Rabenhorst, 1853, Süssw. Diat., p. 47, pl. 5 under Gyrosigma fig. 5a

Frustulia acuminata Kützing, 1833, Linnaea, 1833, p. 555, pl. 14, fig. 36.

Linsley Pond: L-10, 20 ft. (A-1671), 13 ft. – 6 ft. (A-1676-1682), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1686).

Gyrosigma attenuata (Kütz.) Rabenhorst

Gyrosigma attenuata (Kütz.) Rabenhorst, 1853, Süssw. Diat., p. 47.

Frustulia attenuata Kützing, 1833, Linnaea, vol. 8, p. 555, pl. 14, fig. 35.

This species is usually found in fresh or slightly brackish water.

Linsley Pond: L-1A, 11 ft. (A-1631), 8 ft. (A-1637), 6 ft. (A-1640); L-10, 34 ft. (A-1662), 32 ft. (A-1663), 28 ft. – 22 ft. (A-1666-1670), 19 ft.–12 ft. (A-1672-1678), 9 ft. (A-1680), 8 ft. (A-1681), 4 ft. (A-1683), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1686, 1688); L-9, 21 ft. (A-1694), 12 ft. (A-1700), 8 ft. – 2 ft. (A-1702-1705), recent core Deevey and Hutchinson (A-1707); L-2, 14 ft. – 10 ft. (A-1714-1717), 6 ft. (A-1719).

MASTOGLOIA Thwaites

Mastogloia Grevillei W. Smith

Mastogloia Grevillei W. Smith, 1856, Brit. Diat., vol. 2, p. 65, pl. 62, fig. 389.

This species is often found as a littoral form in alpine lakes. It is not of frequent occurrence but is most often found in L-1A.

Linsley Pond: L-1A, 11 ft. – 8 ft. (A-1630-1638); L-10, 38 ft. (A-1658), 34 ft. – 32 ft. (A-1662-1663), 26 ft. (A-1668).

Mastogloia Smithii var. **lacustris** Grunow

Mastogloia Smithii var. *lacustris* Grunow, 1878, in Dr. O. Schneider, Natur. Beitr. z. Kennt. der Kaukasusländer, p. 111.

This species is usually found in littoral regions of fresh or slightly brackish water.

Linsley Pond: L-1A, 13 ft – 6 ft. (A-1625-1641), 4 ft. (A-1643); L-10, 38 ft. – 24 ft. (A-1658-1669), 20 ft. (A-1671), 17 ft. (A-1674), 13 ft. – 12 ft. (A-1676-1678), 9 ft. – 8 ft. (A-1680-1681), recent core Deevey and Hutchinson (A-1686); L-9, 18 ft. – 10 ft. (A-1696-1701), recent core Deevey and Hutchinson (A-1706); L-2, 14 ft. – 6 ft. (A-1714-1719).

FRUSTULIA Agardh

The validity of this generic name will be discussed in a later paper.

Frustulia rhomboides var. **saxonica** (Rabh.) De-Toni

Frustulia rhomboides var. *saxonica* (Rabh.) De-Toni, 1891, Sylloge Algarum, vol. 2, p. 277.

Frustulia saxonica Rabenhorst, 1851, Die Bacillarien Sachens, no. 42.

Linsley Pond: recent core in 9.5 m. water Hutchinson (A-1723).

NEIDIUM Pfitzer

Neidum affine (Ehr.) Cleve

Neidium affine (Ehr.) Cleve, 1894, Sv. Vet. Akad. Handl., vol. 26, no. 2, p. 69.

Navicula affine Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, p. 417, pl. 2, II, fig. 7.

Linsley Pond: L-10, 34 ft. (A-1662), 28 ft. – 19 ft. (A-1666-1672), 13 ft. – 12 ft. (A-1676-1678), 6 ft. (A-1682), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1686).

Neidium Hitchcockii (Ehr.) Cleve

Neidium Hitchcockii (Ehr.) Cleve, 1894, Sv. Vet. Akad. Handl., vol. 26, no. 2, p. 69.

Navicula Hitchcockii Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, p. 418.

This species is usually found in water of cool temperate regions. It has often been reported from Northeastern United States.

Linsley Pond: L-10, 32 ft. (A-1663), 26 ft. (A-1668), 22 ft. – 20 ft. (A-1670-1671), 12 ft. (A-1678), 10 ft. (A-1679), 8 ft. (A-1681), 3 ft. (A-1684); L-2, 13 ft. (A-1715).

Neidium iridis (Ehr.) Cleve

Neidium iridis (Ehr.) Cleve, 1894, Sv. Vet. Akad. Handl., vol. 26, no. 2, p. 69.

Navicula iridis Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, p. 418, pl. 4, figs. 1, 2. It is probable that Ehrenberg put this species in the genus *Pinnularia* at an early date. However, I have not been able to find such a reference.

This species is well distributed in cool temperate regions.

Linsley Pond: L-1A, 11 ft. (A-1630), 9 ft. – 4 ft. (A-1635-1643); L-10, 38 ft. – 17 ft. (A-1658-1674), 12 ft. (A-1678), 6 ft. – 3 ft. (A-1682-1684); L-9, 21 ft. – 20 ft. (A-1694-1695), 18 ft. – 12 ft. (A-1696-1700), 6 ft. (A-1703), 4 ft. (A-1704); L-2, 16 ft. – 15 ft. (A-1712-1713), 13 ft. (A-1715), 8 ft. (A-1718), 6 ft. (A-1719).

STAURONEIS Ehrenberg

Stauroneis acuta W. Smith

Stauroneis acuta W. Smith, 1853, Brit. Diat., vol. 1, p. 59, pl. 19, fig. 187.

This species is found in fresh water. It is often encountered in Northeastern United States. It is present in several levels in the lake sediments, though it is not even of frequent occurrence.

Linsley Pond: L-1A, 8 ft. (A-1637); L-10, 32 ft. (A-1663), 28 ft. (A-1666), 22 ft. (A-1670), 20 ft. (A-1671), 17 ft. (A-1674), 12 ft. (A-1678), 3 ft. (A-1684); L-9, 10 ft. (A-1701), 6 ft. (A-1703), 4 ft. (A-1704), recent core Deevey and Hutchinson (A-1706); L-2, 13 ft. (A-1715), 6 ft. (A-1719).

Stauroneis anceps Ehrenberg

Stauroneis anceps Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, pp. 306, 422, pl. 2, fig. I, 18.

Linsley Pond: L-10, 34 ft.–32 ft. (A-1662-1663), 28 ft.–26 ft. (A-1666-1668), 13 ft. (A-1676), 10 ft. (A-1679), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1686, 1688); L-9, 12 ft. (A-1700), recent core Deevey and Hutchinson (A-1707).

Stauroneis phoenicenteron (Nitzsch) Ehrenberg

Stauroneis phoenicenteron (Nitzsch) Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, pl. 2, fig. V, 1.

Bacillaria phoenicenteron Nitzsch, 1817, N. Schrift. Naturf. Ges. Halle, vol. 3, p. 92.

This species is usually found in ground slime in cool water. Though present in all the profiles, it is of frequent occurrence only in the littoral profile L-1A, and in the 32 ft. level of L-10, where it is evident that a benthic flora extended to a much greater water depth than it does to-day.

Linsley Pond: L-1A, 11 ft.–6 ft. (A-1630-1640); L-10, 32 ft.–3 ft. (A-1663-1684); L-9, 20 ft. (A-1695), 14 ft. (A-1699), 12 ft. (A-1700), 6 ft.–2 ft. (A-1703-1705), recent core Deevey and Hutchinson (A-1706-1708); L-2, 13 ft. (A-1715), 8 ft. (A-1718), 6 ft. (A-1719); recent core in 9.5 m. water Hutchinson (A-1721).

CALONEIS Cleve

Caloneis bacillum (Grun.) Cleve

Caloneis bacillum (Grun.) Cleve, 1894, Le Diatomiste, vol. 2, p. 99.
Stauroneis bacillum Grunow, 1863, Verh. Zool. Bot. Ges. Wien, vol. 13, p. 155, pl. 4 (13 according to Grunow), fig. 16 a, b.

Linsley Pond: L-10, 20 ft.–17 ft. (A-1671-1674), recent core Deevey and Hutchinson (A-1686).

Caloneis Schumanniana (Grun.) Cleve

Caloneis Schumanniana (Grun.) Cleve, 1894, Sv. Vet. Akad. Handl., vol. 26, no. 2, p. 53.
Navicula Schumanniana Grun. apud Van Heurck, 1880, Syn. Diat. Belgique, p. 99, text (1885), pl. 11, fig. 21.

Linsley Pond: recent core in 9.5 m. water Hutchinson (A-1721).

Caloneis silicula (Ehr.) Cleve

Caloneis silicula (Ehr.) Cleve, 1894, Sv. Vet. Akad. Handl., vol. 26, no. 2, p. 51.
Navicula silicula Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, p. 419.

Linsley Pond: L-1A, 9 ft. (A-1636), 8 ft. (A-1637); L-10, 24 ft.–20 ft. (A-1669-1671), 13 ft.–10 ft. (A-1676-1679), 8 ft.–3 ft. (A-1681-1684); L-9, 4 ft. (A-1704).

Caloneis trinodis Boyer

Caloneis trinodis Boyer, 1916, Diat. of Philadelphia and Vicinity, p. 81.
Navicula Trochus var.? *biconstricta* Grun., 1878, Naturw. Beitr. z. Kennt. der Kaukasusländer, p. 112.

This species was first mentioned and illustrated by F. W. Lewis (Notes on New and Rarer Species of Diatomaceae of United States Seaboard). Unfortunately he erroneously thought this species to be the same as *Navicula trinodis* W. Smith. According to the label on what is probably the type slide (Febiger No. 2795) the following information is given. One label in Lewis' handwriting "Navicula trinodis n. sp. Northams Pond, R. I. F. W. L." The other label which I am not so sure is Lewis' reads "Navicula trinodis? n. sp. not named. I do not think it N. Hitchkockii."

Unfortunately I have not seen any of W. Smith's original material. I have seen Van Heurck's Type Syn. Diat. Belgique No. 129 and find that *Achnanthes trinodis* (Arnott) Grun. is not the same as Lewis' specimen. Van Heurck states that *Achnanthes trinodis* is *N. trinodis* W. Sm. partim. I have also seen V. H. No. 146 of *Navicula contenta* Grun. On the folder which goes with the slides (determinations, notes and diagnoses by M. A.

Grunow) it is stated that *N. contenta* is the same as *N. trinodis* W. Sm. var. *biceps* Grun. This does not agree with the V.H. text which infers that *N. contenta* is the same as his illustration in the Atlas of *N. trinodis* W. Sm. forma *minuta*. However I am sure that Lewis' specimens do not belong to the species that is in V.H. No. 146. Thus it seems fairly certain that Lewis' specimens and W. Smith's are not the same.

Linsley Pond: L-1A, 9 ft. (A-1635); L-10, 22 ft. (A-1670), 17 ft. (A-1674), 13 ft. (A-1676), 12 ft. (A-1678), 4 ft. – 3 ft. (A-1683, 1684), bottom of recent core (A-1686).

NAVICULA Bory

Navicula americana Ehrenberg

Navicula americana Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, p. 417.

In America this species has been most frequently found in New England. It is present but not numerous at any level.

Linsley Pond: L-9, 14 ft. – 9 ft. (A-1699-1701b), 4 ft. (A-1704); L-2, 8 ft. (A-1718).

Navicula anglica Ralfs apud Pritchard

Navicula anglica Ralfs apud Pritchard, 1861, Syst. Hist. of the Infusoria, p. 900.

This species occurs at only one level.

Linsley Pond: L-10, 8 ft. (A-1681).

Navicula bacillum Ehrenberg

Navicula bacillum Ehrenberg, 1839, Abhandl. Akad. Wiss. Berlin, 1838, p. 130.

Linsley Pond: L-1A, 9 ft. (A-1635); L-10, 36 ft. – 34 ft. (A-1660-1662), 30 ft. (A-1664), 24 ft. (A-1669), 17 ft. (A-1674), 10 ft. (A-1679), 8 ft.–6 ft. (A-1681-1682), 3 ft. (A-1684).

Navicula cincta (Ehr.) Ralfs apud Pritchard

Navicula cincta (Ehr.) Ralfs apud Pritchard, 1861, Syst. Hist. of the Infusoria, p. 901. Van Heurck gives Kützing credit for this combination, but so far I have been unable to locate Kutzing's published record. Ralfs' publication antedates Van Heurck's.

Pinnularia cincta Ehrenberg, 1854, Mikrogeologie, pl. 10, fig. II, 6.

Linsley Pond: L-2, 12 ft. (A-1716), 6 ft. (A-1719).

Navicula cincta var. **Heufleri** (Grun.) Van Heurck

Navicula cincta var. *Heufleri* (Grun.) Van Heurck, 1880, Syn. Diat. Belgique, p. 82 text (1885), pl. 7, figs. 12, 15.

Navicula Heufleri Grunow, 1860, Verh. Zool. Bot. Ges. Wien, vol. 10, p. 528, pl. 3, fig. 32.

Linsley Pond: L-10, 30 ft. (A-1664), 24 ft. (A-1669), 8 ft. (A-1681), recent core Deevey and Hutchinson (A-1686, 1687).

Navicula cuspidata (Kütz.) Kützing

Navicula cuspidata (Kütz.) Kützing, 1844, Bacill., p. 94, pl. 3, fig. 24.

Frustulia cuspidata Kützing, 1833, Linneae, vol. 8, p. 549, pl. 14, fig. 26.

Linsley Pond: L-10, 34 ft. (A-1662), 32 ft. (A-1663), 28 ft. – 10 ft. (A-1666-1679), 8 ft. – 3 ft. (A-1681-1684), recent core Deevey and Hutchinson (A-1687, 1688); L-9, 2 ft. (A-1705); recent core in 9.5 m. water Hutchinson (A-1721).

Navicula dicephala Ehrenberg

Navicula dicephala Ehrenberg, 1838, Die Infusionsthierchen als Volkommene Organismen, p. 185.

This species is distributed through all the profiles.

Linsley Pond: L-1A, 10 ft. – 6 ft. (A-1633-1640), L-10, 40 ft. (A-1657), 34 ft. – 19 ft. (A-1662-1672), 13 ft. – 10 ft. (A-1676-1679), 8 ft. – 3 ft. (A-1681-1684), recent core Deevey and Hutchinson (A-1686, 1687); L-9, 22 ft. – 20 ft. (A-1693-1695), 16 ft. (A-1698), 12 ft. – 10 ft. (A-1700-1701), 4 ft. (A-1704), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1706); L-2, 14 ft. – 12 ft. (A-1714-1716), 8 ft. (A-1718), 6 ft. (A-1719); recent core in 9.5 m. water Hutchinson (A-1721, 1724).

Navicula exigua (Greg.) O. Müller apud Pantoscek

Navicula exigua (Greg.) O. Müller apud Pantoscek, 1892, Beitr. Kennt. der Foss. Bacill. Ungarns, part III, pl. 3, fig. 45.

Pinnularia exigua Gregory, 1854, Quart. Jour. Mic. Sci., vol. 2, pp. 98-99, pl. 4, fig. 14.

Linsley Pond: L-10, 34 ft. (A-1662), 28 ft. (A-1666), 17 ft. (A-1674), 13 ft. – 12 ft. (A-1676-1678), 9 ft. (A-1680), 4 ft. – 3 ft. (A-1683-1684), recent core Deevey and Hutchinson (A-1687, 1688); L-9, 2 ft. (A-1705); recent core in 9.5 m. water Hutchinson (A-1723).

Navicula gastrum (Ehr.) Donklin

Navicula gastrum (Ehr.) Donklin, 1855, Quart. Jour. Mic., vol. 3, p. 41, pl. 4, fig. 20.

Pinnularia gastrum Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, p. 421, pl. 3, fig. VII, 23.

Linsley Pond: L-1A, 8 ft. (A-1637); L-9, 18 ft. (A-1696).

Navicula graciloides A. Mayer

Navicula graciloides A. Mayer, 1919, Kryptogamische Forschungen, no. 4, p. 203, pl. 7, fig. 60.

This species is well distributed through all the profiles.

Linsley Pond: L-1A, 13 ft. (A-1625), 9 ft. – 6 ft. (A-1635-1640), 3 ft. (A-1644); L-10, 40 ft. – 32 ft. (A-1657-1663), 28 ft. – 8 ft. (A-1666-1681), 4 ft. – 3 ft. (A-1683-1684), recent core Deevey and Hutchinson (A-1686, 1687); L-9, 25 ft. (A-1690), 22 ft. – 20 ft. (A-1693-1695), 18 ft. (A-1696), 16 ft. – 12 ft. (A-1698-1700), 8 ft. (A-1702), 4 ft. (A-1704), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1706-1708); L-2, 16 ft. – 6 ft. (A-1712-1719); recent core in 9.5 m. water Hutchinson (A-1721, 1722, 1725).

Navicula minuscula Grunow apud Van Heurck

Navicula minuscula Grunow apud Van Heurck, 1880, Syn. Diat. Belgique, pl. 14, fig. 3.

Linsley Pond: recent core in 9.5 m. water Hutchinson (A-1724).

Navicula oblonga (Kütz.) Kützing

Navicula oblonga (Kutz.) Kützing, 1844, Bacill., p. 97, pl. 4, fig. 21.
Frustulia oblonga Kutzing, 1834, Alg. Dec., no. 84.

Linsley Pond: L-1A, 9 ft. – 6 ft. (A-1635-1640); L-10, 38 ft. – 17 ft. (A-1658-1674), 13 ft. – 3 ft. (A-1676-1684), recent core Deevey and Hutchinson (A-1686, 1687); L-9, 16 ft. (A-1698), 4 ft. (A-1704), 2 ft. (A-1705); L-2, 14 ft. – 10 ft. (A-1714-1717), 6 ft. (A-1719); recent core in 9.5 m. water Hutchinson (A-1722, 1725).

Navicula peregrina (Ehr.) Kützing

Navicula peregrina (Ehr.) Kützing, 1844, Bacill., p. 97, pl. 28, fig. 52.
Pinnularia peregrina Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, p. 421, pl. 2, fig. IV, 1.

This species is typically found in north temperate habitats.

Linsley Pond: L-10, 38 ft. – 32 ft. (A-1658-1663), 28 ft. – 17 ft. (A-1666-1674), 13 ft. – 12 ft. (A-1676-1678), 9 ft. – 8 ft. (A-1680-1681), recent core Deevey and Hutchinson (A-1687); L-9, 21 ft. (A-1694), 16 ft. (A-1698), 12 ft. (A-1700), 8 ft. (A-1702), 6 ft. (A-1703); L-2, 16 ft. (A-1712), 8 ft. (A-1718), 6 ft. (A-1719).

Navicula protracta Grunow apud Cleve and Grunow

Navicula protracta Grunow apud Cleve and Grunow, 1880, Sv. Vet. Akad. Handl., vol. 17, no. 2, p. 35, pl. 2, fig. 38.

This species is typically found in slightly brackish water or in water with a high mineral content. It is well distributed through all the profiles, but is not found in the earliest sediments of the lake.

Linsley Pond: L-1A, 13 ft. – 5 ft. (A-1625-1642); L-10, 38 ft. – 3 ft. (A-1658-1684), recent core Deevey and Hutchinson (A-1686, 1687); L-9, 24 ft. – 2 ft. (A-1691-1705), recent core Deevey and Hutchinson (A-1706-1707); L-2, 17 ft. – 6 ft. (A-1711-1719); recent core in 9.5 m. water Hutchinson (A-1723, 1725).

Navicula pupula var. **capitata** Hustedt apud A. Pascher

Navicula pupula var. *capitata* Hustedt apud A. Pascher, 1930, Süsswasser-Flora Mitteleuropas, heft 10, Bacill., p. 281, fig. 467-c. I cannot find any earlier reference for this variety. Mills erroneously cites the report of the Sven Hedin Expedition to Southern Tibet.

Linsley Pond: L-10, 38 ft. (A-1658), 28 ft. – 15 ft. (A-1666-1675), 12 ft. (A-1678), 8 ft. (A-1681), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1686-1688); recent core in 9.5 m. water Hutchinson (A-1721).

Navicula pupula var. **rectangularis** (Greg.) Grunow apud Cleve and Grunow

Navicula pupula var. *rectangularis* (Greg.) Grunow apud Cleve and Grunow, 1880, Sv. Vet. Akad. Handl., vol. 17, no. 2, p. 45.
Stauroneis rectangularis Gregory, 1854, Quart. Jour. Mic. Sci., vol. 2, p. 99, pl. 6, fig. 17.

Linsley Pond: L-1A, 8 ft. (A-1637); L-10, 32 ft. (A-1663), 28 ft. – 19 ft. (A-1666-1672), 15 ft. – 8 ft. (A-1675-1681), 3 ft. (A-1684), recent core

Deevey and Hutchinson (A-1686, 1687); L-9, 22 ft. (A-1693), 20 ft. (A-1695).

Navicula radiosa Kutzing

Navicula radiosa Kützing, 1844, Bacill., p. 91, pl. 4, fig. 23.

Linsley Pond: L-1A, 10 ft. (A-1633), 8 ft. (A-1637), 6 ft. (A-1640), 3 ft. (A-1644), 1 ft. (A-1648), shallow water November 1941 Patrick (A-1652); L-10, 38 ft. – 3 ft. (A-1657-1684), recent core Deevey and Hutchinson (A-1686-1688), plankton May 1938 Riley (A-1596); L-9, 21 ft. – 20 ft. (A-1694-1695), 10 ft. (A-1701), 6 ft. – 2 ft. (A-1703-1705), recent core Deevey and Hutchinson (A-1706-1708); L-2, 12 ft. (A-1716); recent core in 9.5 m. water Hutchinson (A-1721, 1722, 1725).

Navicula radiosa var. **tenella** (Bréb.) Cleve

Navicula radiosa var. *tenella* (Bréb.) Cleve, 1895, Sv. Vet. Akad. Handl., vol. 27, no. 3, p. 17.

Navicula tenella Brébisson ex Kützing, 1849, Spec. Algarum, p. 74.

Linsley Pond: L-10, 36 ft. (A-1660), 32 ft. – 19 ft. (A-1663-1672), 13 ft. – 10 ft. (A-1676-1679), 8 ft. (A-1681), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, recent core Deevey and Hutchinson (A-1708); recent core in 9.5 m. water Hutchinson (A-1725).

Navicula Reinhardtii (Grun.) Van Heurck

Navicula Reinhardtii (Grun.) Van Heurck, 1880, Syn. Diat. Belgique, pl. 7, figs. 5, 6, text (1885), p. 86.

Stauroneis Reinhardtii Grunow, 1860, Verh. Zool. Bot. Ges. Wien, vol. 10, p. 566, pl. 6, fig. 19.

Linsley Pond: L-10, 38 ft.–32 ft. (A-1658-1663), 26 ft.–22 ft. (A-1668-1670), 13 ft. – 12 ft. (A-1676-1678), 8 ft. (A-1681), recent core Deevey and Hutchinson (A-1686-1688).

Navicula Schonfeldii Hustedt apud A. Pascher

Navicula Schonfeldii Hustedt apud A. Pascher, 1930, Süsswasser-Flora Mitteleuropas, heft 10, p. 301, fig. 520.

Linsley Pond: L-10, recent core Deevey and Hutchinson (A-1687); recent core in 9.5 m. water Hutchinson (A-1721).

Navicula scutelloides W. Sm. ex Gregory

Navicula scutelloides W. Sm. ex Gregory, 1856, Quart. Jour. Mic. Sci., vol. 4, p. 4, pl. 1, fig. 15. W. Smith in "The British Diatomaceae" cites the above reference as authoritative for the species.

This species is present in all the profiles. It is most frequent in the earlier sediments of the lake.

Linsley Pond: L-1A, 15 ft. – 14 ft. (A-1620-1623); L-10, 36 ft. (A-1660), 32 ft. (A-1663), 30 ft. – 20 ft. (A-1664-1671), 17 ft. (A-1674), 13 ft. (A-1676), recent core Deevey and Hutchinson (A-1686, 1687); L-9, 22 ft.–20 ft. (A-1693-1695), 18 ft. (A-1696), 14 ft. – 10 ft. (A-1699-1701), recent core Deevey and Hutchinson (A-1707); L-2, 17 ft. – 15 ft. (A-1711-1713).

Navicula tuscula (Ehr.) Kützing

Navicula tuscula (Ehr.) Kützing, 1844, Bacill., p. 96.

Navicula (*Pinnularia*) *tuscula* Ehrenberg, 1840, Bertichte Akad. Wiss. Berlin, 1840, p. 215. It is evident from the context of Ehrenberg's paper that he believed this species should be included under *Pinnularia*.

Linsley Pond: L-1A, 13 ft. (A-1625), 11 ft. (A-1630), 9 ft. – 6 ft. (A-1635-1640); L-10, 40 ft – 24 ft. (A-1657-1669), 20 ft. (A-1671), 17 ft. – 3 ft. (A-1674-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, 21 ft. (A-1694), 16 ft. – 12 ft. (A-1689-1700), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1707); L-2, 12 ft. (A-1716), 8 ft. (A-1718), 6 ft. (A-1719); recent core in 9.5 m. water Hutchinson (A-1722, 1723).

PINNULARIA Ehrenberg

The *Pinnularia* flora, though well diversified, is not well developed in Linsley Pond. A few species are of frequent or better occurrence.

Pinnularia acrosphaeria W. Sm.

Pinnularia acrosphaeria W. Smith, 1853, Brit. Diat., vol. 1, p. 58, pl. 19, fig. 183.

This species is often accredited to Brebisson and Rabenhorst. I have seen specimens from Brebisson's herbarium (Crypt. Herb. Field Museum) labeled *Navicula acrosphaeria* which are not the same as the specimens of *Pinnularia acrosphaeria* W. Sm., but belong to *Pinnularia gibba* as Smith suggests. Unfortunately I have seen none of Smith's specimens, but from his illustrations my specimens belong to this species. Rabenhorst's *Pinnularia acrosphaeria* which was published the same year as Smith's is not the same. As the present concept of *P. acrosphaeria* is more nearly that of Smith and as it is difficult to determine which publication was first, as they both appeared the same year, I shall retain Smith's name for the species commonly called by this name to-day.

Linsley Pond: L-10, 12 ft. (A-1678), 8 ft. (A-1681).

Pinnularia bihastata Mann

Pinnularia bihastata Mann, 1924, Jour. Wash. Acad. Sci., vol. 14, p. 30.

Mann gives this name to Cleve's *Pinnularia trigonocephala* because it is a later homonym.

Linsley Pond: L-10, 20 ft. – 17 ft. (A-1671-1674), 10 ft. (A-1679), 3 ft. (A-1684); L-9, 4 ft. (A-1704), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1707).

Pinnularia Braunii (Grun.) Cleve

Pinnularia Braunii (Grun.) Cleve, 1895, Sv. Vet. Akad. Handl., vol. 27, no. 3, p. 75.

Navicula Braunii Grun. apud Van Heurck, 1880, Syn. Diat. Belgique, pl. 6, fig. 21, text (1885) p. 79.

Linsley Pond: L-10, 38 ft. (A-1658), 34 ft. (A-1662), 8 ft. (A-1681).

Pinnularia hemiptera (Kütz.) W. Sm.

Pinnularia hemiptera (Kütz.) W. Smith, 1856, Brit. Diat., vol. 2, p. 95.
Navicula hemiptera Kützing, 1844, Bacill., p. 97, pl. 30, fig. 11.

Linsley Pond: L-10, 32 ft. (A-1663), 28 ft. – 26 ft. (A-1666-1668), 20 ft. (A-1671), 17 ft. (A-1674), 13 ft. – 12 ft. (A-1676-1678); L-9, 8 ft. (A-1702).

Pinnularia interrupta W. Smith

Pinnularia interrupta W. Smith, 1853, Brit. Diat., vol. 1, p. 59, pl. 19, fig. 184.

Linsley Pond: L-10, 38 ft. (A-1658).

Pinnularia maior (Kütz.) W. Smith

Pinnularia maior (Kütz.) W. Smith, 1853, Brit. Diat., vol. 1, p. 54, pl. 18, fig. 162.
Frustulia maior Kützing, 1833, Syn. Diat., p. 547, pl. 14, fig. 25.

This species is most frequent in L-1A.

Linsley Pond: L-1A, 9 ft. – 6 ft. (A-1635-1641); L-10, 38 ft. (A-1658), 32 ft. (A-1663), 26 ft. – 20 ft. (A-1668-1671), 17 ft. (A-1674), 8 ft. (A-1681), 3 ft. (A-1684); L-9, 18 ft. (A-1696); L-2, 10 ft. (A-1717); recent core in 9.5 m. water Hutchinson (A-1723).

Pinnularia mesogongyla Ehrenberg

Pinnularia mesogongyla Ehrenberg. This species is briefly described as a new species by Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, p. 421. It is recognizably illustrated by Ehrenberg, 1870, Abhandl. Akad. Wiss. Berlin, 1870, pl. 2, fig. 16.

Linsley Pond: L-10, 20 ft. (A-1671), 12 ft. (A-1678), 10 ft. (A-1679).

Pinnularia mesolepta (Ehr.) W. Smith

Pinnularia mesolepta (Ehr.) W. Smith, 1853, Brit. Diat., vol. 1, p. 58, pl. 19, fig. 182.
Navicula mesolepta Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, p. 419, pl. 4, fig. II, 4.

Linsley Pond: L-10, 28 ft. (A-1666).

Pinnularia mesolepta var. **stauroneiformis** (Grun.) Cleve

Pinnularia mesolepta var. *stauroneiformis* (Grun.) Cleve, 1895, Sv. Vet. Akad. Handl., vol. 27, no. 3, p. 76.
Navicula mesolepta var. *stauroneiformis* Grunow, 1860, Verh. Zool. Bot. Ges. Wien, vol. 10, p. 520, pl. 4 (Grunow pl. 2), fig. 22b.

Linsley Pond: L-9, 22 ft. (A-1693).

Pinnularia microstauron (Ehr.) Cleve

Pinnularia microstauron (Ehr.) Cleve, 1891, Acta Soc. pro Fauna et Flora Fennica, vol. 8, no. 2, p. 28.
Stauroptera microstauron Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, p. 423, pl. 1, fig. IV, 1, pl. 4, fig. II, 2.

Linsley Pond: L-10, 26 ft. –20 ft. (A-1668-1671).

Pinnularia nobilis Ehrenberg

Pinnularia nobilis Ehrenberg, 1840, Berichte Akad. Wiss. Berlin, 1840, p. 214.

Linsley Pond: L-10, 12 ft. (A-1678), 6 ft. (A-1682), recent core Deevey and Hutchinson (A-1687); L-9, 14 ft. (A-1699), 12 ft. (A-1700), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1707); L-2, 6 ft. (A-1719).

Pinnularia nodosa (Ehr.) W. Smith

Pinnularia nodosa (Ehr.) W. Smith, 1856, Brit. Diat., vol. 2, p. 96.
Navicula nodosa Ehrenberg, 1838, Die Infusionsthierchen als Volkommene Organismen, p. 179, pl. 13, fig. 9.

Linsley Pond: L-10, 34 ft. (A-1662), 28 ft. – 26 ft. (A-1666-1668), 22 ft. (A-1670), 17 ft. (A-1674), 6 ft. (A-1682); L-9, 21 ft.–20 ft. (A-1694-1695).

Pinnularia stauroptera (Grun.) Rabenhorst

Pinnularia stauroptera (Grun.) Rabenhorst, 1864, Flora Europaea Algarum, p. 222.
Navicula stauroptera Grunow, 1860, Verh. Zool. Bot. Ges. Wien, vol. 10, p. 516.

Grunow states that this species is synonymous with *Stauroptera parva* Ehrenberg. However, the species name *parva* in the genus *Pinnularia* is preoccupied by *Pinnularia parva* Gregory, 1854, Quart. Jour. Mic. Sci., vol. 2, p. 98, pl. 4, fig. 11. Thus in transferring this species to the genus *Pinnularia*, the name *stauroptera* becomes legitimate.

I see no reason to synonymize this species with *Pinnularia gibba* Ehr., as Hustedt has done. I have studied Ehrenberg's original descriptions and illustrations and also those of Grunow. Originally these two species certainly referred to very different diatoms. After a careful study of specimens in Cleve and Moeller's exsiccatae, which were determined by Grunow, and of Grunow's illustrations, I find that my specimens are most certainly species agreeing with the illustration in his diatoms of Franz Josefs-Land (Denk. math. Kaiser Akad. Wissenschaften, vol. 48, pl. 1, fig. 18).

Linsley Pond: L-10, 28 ft. (A-1666), 22 ft. (A-1670), 13 ft. – 10 ft. (A-1676-1679), 6 ft. – 3 ft. (A-1682-1684), recent core Deevey and Hutchinson (A-1686); recent core in 9.5 m. water Hutchinson (A-1723, 1725).

Pinnularia stomatophora (Grun.) Cleve

Pinnularia stomatophora (Grun.) Cleve, 1895, Sv. Vet. Akad. Handl., vol. 27, no. 3, p. 83.
Navicula stomatophora Grunow, 1876, in A. Schmidt's Atlas, pl. 44, figs. 24, 26.

Linsley Pond: L-10, 28 ft. (A-1666), 26 ft. (A-1668), 12 ft. (A-1678).

Pinnularia streptoraphe Cleve

Pinnularia streptoraphe Cleve, 1891, Acta Soc. pro Fauna et Flora Fennica, vol. 8, no. 2, p. 23. Cleve refers to A. Schmidt's Atlas, pl. 42, fig. 7, for an illustration.

Linsley Pond: L-9, 4 ft. (A-1704).

Pinnularia viridis (Nitzsch) Ehrenberg

Pinnularia viridis (Nitzsch) Ehrenberg, 1843, Abhandl. Akad. Wiss. Berlin, 1841, pl. 1, figs. I, 7; III, 3; IV, 3.
Bacillaria viridis Nitzsch, 1817, N. Schrift. Naturf. Ges. Halle, vol. 3, no. 1, p. 99, pl. 6, figs. 1-3.

Linsley Pond: L-1A, 13 ft. (A-1625), 11 ft. (A-1630), 9 ft. – 4 ft. (A-1635-1643), shallow water November 1941 Patrick (A-1652); L-10, 34 ft. (A-1662), 30 ft. (A-1664), 26 ft. (A-1668), 22 ft. – 19 ft. (A-1670-1672), 15 ft. – 10 ft. (A-1675-1679), 8 ft. – 3 ft. (A-1681-1684), recent core Deevey and Hutchinson (A-1686); L-9, 23 ft. (A-1692), 18 ft. – 2 ft. (A-1696-1705), recent core Deevey and Hutchinson (A-1706), L-2, 16 ft. (A-1712), 13 ft.– 10 ft. (A-1715-1717), 6 ft. (A-1719); recent core in 9.5 m. water Hutchinson (A-1721).

AMPHIPRORA Ehrenberg

Amphiprora ornata Bailey

Amphiprora ornata Bailey, 1850, Smithsonian Contributions to Knowledge, vol. 2, art. 8, p. 38, pl. 2, figs. 15, 23.

Linsley Pond: L-9, recent core Deevey and Hutchinson (A-1707).

CYMBELLA Agardh

Cymbella affinis Kützing

Cymbella affinis Kützing, 1844, Bacill., p. 80, pl. 6, fig. 15.

Linsley Pond: L-1A, 9 ft. – 8 ft. (A-1635-1637); L-10, 38 ft. – 32 ft. (A-1658-1663), 28 ft. – 24 ft. (A-1666-1669), 20 ft. (A-1671), 15 ft. – 13 ft. (A-1675-1676), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1687).

Cymbella amphicephala Naegeli ex Kützing

Cymbella amphicephala Naegeli ex Kützing, 1849, Spec. Algarum, p. 860.

Linsley Pond: L-1A, 7 ft. (A-1639); L-10, 34 ft. – 24 ft. (A-1662-1669), 20 ft. – 19 ft. (A-1671-1672), 15 ft. – 6 ft. (A-1675-1682), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1688).

Cymbella angustata (W. Sm.) Cleve

Cymbella angustata (W. Sm.) Cleve, 1894, Sv. Vet. Akad. Handl., vol. 26, no. 2, p. 161.
Navicula angustata W. Smith, 1853, Brit. Diat., vol. 1, p. 53, pl. 17, fig. 156.

Linsley Pond: L-10, 28 ft. – 19 ft. (A-1666-1672), 15 ft. – 13 ft. (A-1675-1676), 8 ft. (A-1681), 4 ft. (A-1683), recent core Deevey and Hutchinson (A-1687).

Cymbella aspera (Ehr.) Heribaud

Cymbella aspera (Ehr.) Heribaud, 1893, Diat. Auvergne, p. 69, pl. 3, fig. 10.
Cocconeis asperum Ehrenberg, 1839, Berichte Akad. Wiss. Berlin, 1839, p. 30.

This species, though present in all the profiles, is of frequent occurrence only in L-1A.

Linsley Pond: L-1A, 8 ft. – 6 ft. (A-1637-1640), 4 ft. (A-1643), 3 ft. (A-1646), shallow water November 1941 Patrick (A-1652); L-10, 34 ft.– 32 ft. (A-1662-1663), 22 ft. – 3 ft. (A-1670-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, 14 ft. – 12 ft. (A-1699-1700), 9 ft. – 2 ft. (A-1701b-1705), recent core Deevey and Hutchinson (A-1706); L-2, 13 ft. (A-1715), 6 ft. (A-1719); recent core in 9.5 m. water Hutchinson (A-1723).

Cymbella Cessatii Grunow

Cymbella Cesatii Grunow, 1881, ex A. Schmidt's Atlas, pl. 71, figs. 48-49.

According to Hustedt this species is characteristic of mountainous regions. It is recorded at only a few levels in Linsley Pond. It was occasionally seen at these levels, but was very scarce. Thus it may be a contamination brought in by wind rather than part of the flora.

Linsley Pond: L-10, 28 ft. (A-1666), 24 ft. – 20 ft. (A-1669-1671), 13 ft. (A-1676), 3 ft. (A-1684).

Cymbella cistula (Hempr.) Kirchner

Cymbella cistula (Hempr.) Kirschner, 1878, in F. Cohn's Kryptogamen-Flora von Schles., vol. 2, p. 189.

Cocconema cistula Ehr. apud Hemprich and Ehrenberg, 1831, Symbolae Physicae: Animalia Evertebrata Exclusis Insectis—First Series, no page number, pl. 2, fig. 10.

This species is frequent and well distributed in all the profiles.

Linsley Pond: L-1A, 13 ft. (A-1625), 9 ft. – 7 ft. (A-1635-1639), 3 ft. (A-1644), 1 ft. (A-1648), shallow water November 1941 Patrick (A-1652); L-10, 40 ft. – 38 ft. (A-1657-1659), 34 ft. – 32 ft. (A-1662-1663), 28 ft.–3 ft. (A-1666-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, 21 ft. – 20 ft. (A-1694-1695), 18 ft. (A-1696), 14 ft. – 10 ft. (A-1699-1701), 8 ft. – 6 ft. (A-1702-1703), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1707-1708); L-2, 16 ft. – 13 ft. (A-1712-1715), 10 ft. – 6 ft. (A-1717-1719); recent core in 9.5 m. water Hutchinson (A-1725), plankton May 1938 Riley (A-1596).

Cymbella cuspidata Kützing

Cymbella cuspidata Kützing, 1844, Bacill., p. 79, pl. 3, fig. 40.

This species is most frequent in L-1A, and L-10, but is present in all profiles.

Linsley Pond: L-1A, 11 ft. (A-1630), 9 ft. – 7 ft. (A-1635-1639); L-10, 38 ft. (A-1658), 34 ft. – 32 ft. (A-1662-1663), 26 ft. – 3 ft. (A-1668-1684), recent core Deevey and Hutchinson (A-1686-1687); L-9, 22 ft. – 21 ft. (A-1693-1694), 18 ft. (A-1696), 14 ft.–10 ft. (A-1699-1701), recent core Deevey and Hutchinson (A-1706); recent core in 9,5 m. water Hutchinson (A-1723).

Cymbella cymbiformis Agardh

Cymbella cymbiformis Agardh, 1830, Conspect. Crit. Diat., p. 10.

Linsley Pond: L-1A, 10 ft. (A-1634), 7 ft. (A-1639).

Cymbella delicatula Kützing

Cymbella delicatula Kützing, 1849, Spec. Algarum, p. 59.

This species is usually found in mountainous regions. It is recorded in only a few levels from Linsley Pond, and in none is of frequent occurrence.

Linsley Pond: L-10, 36 ft. (A-1660), 26 ft. (A-1668), 22 ft. – 20 ft. (A-1670-1671); recent core in 9.5 m. water Hutchinson (A-1723).

Cymbella Ehrenbergii Kutzing

Cymbella Ehrenbergii Kützing, 1844, Bacill., p. 79, pl. 6, fig. 11.

This species is well distributed in L-1A, and is frequent in the earlier sediments of L-10, which fact supports the theory that littoral vegetation once extended farther into the lake than it does to-day.

Linsley Pond: L-1A, 13 ft. – 11 ft. (A-1627-1630), 9 ft. – 5 ft. (A-1635-1642); L-10, 38 ft. (A-1658), 34 ft. – 13 ft. (A-1662-1676); L-9, 20 ft. (A-1695), 18 ft. – 4 ft. (A-1696-1704); L-2, 16 ft. (A-1712), 15 ft. (A-1713), 12 ft. (A-1716), 10 ft. (A-1717), 6 ft. (A-1719).

Cymbella hybrida Grunow ex Cleve

Cymbella hybrida Grunow ex Cleve, 1894, Sv. Vet. Akad. Handl., vol. 26, no. 2, p. 166, pl. 4, fig. 23. This species name first appeared on the labels of Cleve and Möller Type Slide No. 161 in 1878. However, there is no description of the species.

Linsley Pond: L-10, 32 ft. (A-1663).

Cymbella naviculiformis Auerswald

Cymbella naviculiformis Auerswald, 1861, in Rabenhorst Algen Europa, no. 1065.

Linsley Pond: L-1A, 8 ft. (A-1637); L-10, 38 ft. (A-1658), 34 ft. (A-1662), 28 ft. – 26 ft. (A-1666-1668), 22 ft. (A-1670), 15 ft. – 13 ft. (A-1675-1676), 3 ft. (A-1684); recent core in 9.5 m. water Hutchinson (A-1723).

Cymbella rupicola Grunow

Cymbella rupicola Grunow, 1881, ex A. Schmidt's Atlas, pl. 71, fig. 70.

This species is usually found in cool temperate and northern regions.

Linsley Pond: L-1A, 10 ft. – 6 ft. (A-1633-1640), 4 ft. (A-1643); L-10, 38 ft. – 36 ft. (A-1658-1660), 32 ft. – 20 ft. (A-1663-1671), 13 ft. (A-1676), recent core Deevey and Hutchinson (A-1687).

Cymbella scotica W. Smith

Cymbella scotica W. Smith, 1853, Brit. Diat., vol. 1, p. 18, pl. 2, fig. 25. This species is sometimes referred to as *Cymbella gracilis* (Rabh.) Cl. However, this is not a valid name as *Cymbella gracilis* (Ehr.) Kütz. is an older combination. I do not believe these two species are the same. Certainly the plates figure quite different forms. Unfortunately I have not seen original material.

Linsley Pond: L-1A, 8 ft. (A-1637); L-10, 32 ft. – 30 ft. (A-1663-1664), 24 ft. (A-1669), 20 ft. – 8 ft. (A-1671-1681), 4 ft. – 3 ft. (A-1683-1684), recent core Deevey and Hutchinson (A-1686-1687); L-9, 22 ft. (A-1693), 21 ft. (A-1694), 12 ft. (A-1700), recent core Deevey and Hutchinson (A-1707).

Cymbella similis new species Plate 12, fig. 1.

Valvis lanceolatis, 24.5 μ longis, 7 μ latis, apicis rotundatis vel leviter rostratis; raphe subrecta leviter excentrica; zona hyalina circa nodulum centralem paullisper dilatata; striis subtiliter punctatis 12-14 in 10 μ, pl. 12, fig. 1.

This is a variable species. Figure 4 illustrates an extreme variant. This species may be 19-25 μ long and 6-8 μ broad. Striae 10-14 in 10 μ.

Cymbella similis resembles *Cymbella obtusa* var. *subaequalis* (Grun.) Cl. as described by Cleve. Unfortunately, I do not have any of Cleve's material, but have studied Van Heureck's Type Slide No. 29, which is quite different from my specimens. The raphe of the latter are straight while the raphe in the specimens on Van Heurck's slide are twisted. The striae of my specimens are about 14 in 10 microns at the ends of the valve. Those of Cleve's specimens are given as 10-11 in 10 microns at the ends of the valve. At first glance this species might appear to belong to the genus *Navicula*, but after careful examination of this diatom in the girdle and valve aspects, I have placed it in the genus *Cymbella*.

This species seems to be well distributed in the earlier sediments of the lake.

TYPE.—L-9, 24 ft. Acad. Nat. Sci. Phila., no. 1726.

Linsley Pond: L-1A, 14 ft. – 11 ft. (A-1623-1632); L-10, 40 ft. – 34 ft. (A-1657-1662), 13 ft. (A-1676), 8 ft. (A-1681); L-9, 25 ft. – 19 ft. (A-1690-1695b); L-2, 17 ft. – 14 ft. (A-1711-1714).

Cymbella turgida Gregory

Cymbella turgida Gregory, 1856, Quart. Jour. Micr. Sci., vol. 4, p. 5, pl. 1, fig. 18.

Linsley Pond: L-1A, 9 ft. (A-1635); L-10, 34 ft. (A-1662), 28 ft. – 26 ft. (A-1666-1668), 17 ft. (A-1674), 13 ft. – 12 ft. (A-1676-1678), 6 ft. (A-1682); L-2, 16 ft. (A-1712); recent core in 9.5 m. water Hutchinson (A-1725).

Cymbella ventricosa Agardh

Cymbella ventricosa Agardh, 1830, Conspect. Crit. Diat., part 1, p. 9.

This species is both a plankton and littoral form. It is well distributed throughout the profiles.

Linsley Pond: L-1A, 13 ft. – 12 ft. (A-1625-1628), 10 ft. – 6 ft. (A-1633-1640); L-10, 38 ft. (A-1658), 30 ft. – 19 ft. (A-1664-1672), 15 ft. – 6 ft. (A-1675-1682), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1686, 1687); L-9, 25 ft. (A-1690), 23 ft. (A-1692), 21 ft. (A-1694), 20 ft. (A-1695), 14 ft.– 10 ft. (A-1699-1701), 6 ft. (A-1703), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1706-1708); L-2, 16 ft. (A-1712), 13 ft. (A-1715), 8 ft. (A-1718), 6 ft. (A-1719); recent core in 9.5 m. water Hutchinson (A-1721, 1722, 1725).

GOMPHONEMA Agardh

Gomphonema acuminatum Ehrenberg

Gomphonema acuminatum Ehrenberg, 1832, Abhandl. Akad. Wiss. Berlin, 1831, p. 88.

Linsley Pond: L-10, 22 ft. (A-1670), 13 ft. – 9 ft. (A-1676-1680), 6 ft. (A-1682), recent core Deevey and Hutchinson (A-1686-1688); L-9, 6 ft. (A-1703), recent core Deevey and Hutchinson (A-1706, 1707); L-2, 16 ft.

(A-1712), 6 ft. (A-1719); recent core in 9.5 m. water Hutchinson (A-1725).

Gomphonema acuminatum var. **coronata** (Ehr.) Rabenhorst

Gomphonema acuminatum var. *coronata* (Ehr.) Rabenhorst, 1864, Flora Europaea Algarum, p. 290.

Gomphonema coronatum Ehrenberg, 1840, Berichte Akad. Wiss. Berlin, 1840, p. 211.

This variety is well distributed in Linsley Pond.

Linsley Pond: L-1A, 13 ft. – 7 ft. (A-1625-1639), 3 ft. (A-1644), 1 ft. (A-1648); L-10, 38 ft. –3 ft. (A-1658-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, 21 ft. (A-1694), 14 ft. (A-1699), 10 ft. (A-1701), 4 ft. (A-1704), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1707-1708); L-2, 8 ft. (A-1718), 6 ft. (A-1719).

Gomphonema acuminatum var. **pusilla** Grunow apud Van Heurck

Gomphonema acuminatum var. *pusilla* Grunow apud Van Heurck, 1880, Syn. Diat. Belgique, pl. 23, fig. 19.

Linsley Pond: L-1A, 11 ft. – 8 ft. (A-1630-1638); L-10, 34 ft. (A-1662), 28 ft. – 26 ft. (A-1666-1668), 20 ft. (A-1671), 13 ft. – 10 ft. (A-1676-1679), 8 ft. – 6 ft. (A-1681-1682), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1688); L-9, 16 ft. (A-1698), 2 ft. (A-1705).

Gomphonema angustata (Kütz.) Rabenhorst

Gomphonema angustata (Kütz.) Rabenhorst, 1864, Flora Europaea Algarum, p. 283.

Sphenella angusta Kützing, 1844, Bacill., p. 83, pl. 8, fig. 4.

Linsley Pond: L-10, recent core Deevey and Hutchinson (A-1686-1688).

Gomphonema augur Ehrenberg

Gomphonema augur Ehrenberg, 1840, Berichte Akad. Wiss. Berlin, 1840, p. 211.

Linsley Pond: L-1A, 8 ft. (A-1637), 3 ft. (A-1646); L-10, 22 ft. (A-1670), 17 ft. (A-1674), 13 ft. – 8 ft. (A-1676-1681), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1686, 1687).

Gomphonema constrictum Ehrenberg

Gomphonema constrictum Ehrenberg, 1832, Abhandl. Akad. Wiss. Berlin, 1830, p. 63.

Linsley Pond: L-1A, 9 ft. – 7 ft. (A-1635-1639); L-10, 34 ft. – 32 ft. (A-1662-1663), 28 ft. – 10 ft. (A-1666-1679), 8 ft. (A-1681), 4 ft. – 3 ft. (A-1683-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, recent core Deevey and Hutchinson (A-1707).

Gomphonema constrictum var. **capitata** (Ehr.) Van Heurck

Gomphonema constrictum var. *capitata* (Ehr.) Van Heurck, 1880, Syn. Diat. Begique, pl. 23, fig. 7, text (1885), p. 123.

Gomphonema capitatum Ehrenberg, 1838, Die Infusionthierchen als Volkommene Organismen, p. 217, pl. 18, fig. 2.

Linsley Pond: L-1A, shallow water November 1941 Patrick (A-1652); L-10, 28 ft. (A-1666), 22 ft. (A-1670), 17 ft. – 12 ft. (A-1674-1678), 8 ft.–

3 ft. (A-1681-1684), recent core Deevey and Hutchinson (A-1686-1687); L-9, recent core Deevey and Hutchinson (A-1707, 1708); recent core in 9.5 m. water Hutchinson (A-1723).

Gomphonema gracile var. **dichotoma** (W. Sm.) Van Heurck

Gomphonema gracile var. *dichotoma* (W. Sm.) Van Heurck, 1896, Treat. Diat., p. 273, pl. 7, fig. 310.

Gomphonema dichotomum W. Smith, 1853, Syn. Brit. Diat., vol. 1, p. 79, pl. 28, fig. 240.

Linsley Pond: recent core in 9.5 m. water Hutchinson (A-1725).

Gomphonema intricatum var. **pumila** Grunow apud Van Heurck

Gomphonema intricatum var. *pumila* Grunow apud Van Heurck, 1880, Syn. Diat. Belgique, pl. 24, figs. 35, 36.

Linsley Pond: L-1A, 9 ft.–8 ft. (A-1635-1637); L-10, 36 ft. (A-1660), 32 ft. (A-1663), 28 ft.–20 ft. (A-1666-1671), 17 ft.–12 ft. (A-1674-1678), 8 ft. (A-1681), 4 ft.–3 ft. (A-1683-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, 12 ft. (A-1700), 9 ft. (A-1701b), 4 ft. (A-1704), 2 ft. (A-1705), recent core Deevey and Hutchinson (A-1706-1708); recent core in 9.5 m. water Hutchinson (A-1723).

Gomphonema sphaerophorum Ehrenberg

Gomphonema sphaerophorum Ehrenberg, 1845, Berichte Akad. Wiss. Berlin, 1845, p. 78.

Linsley Pond: L-10, 38 ft. (A-1658), 15 ft. (A-1675), 10 ft. (A-1679), recent core Deevey and Hutchinson (A-1688); L-9, recent core Deevey and Hutchinson (A-1706).

Gomphonema subtile var. **sagitta** (Schum.) Grunow apud Van Heurck

Gomphonema subtile var. *sagitta* (Schum.) Grunow apud Van Heurck, 1880, Syn. Diat. Belgique, pl. 23, fig. 27.

Gomphonema sagitta Schuman, 1863, Schrift. Phys. Ökon. Gesell. Königsburg, vol. 3, p. 187, pl. 9, fig. 29 a-d.

Linsley Pond: L-1A, 11 ft.–7 ft. (A-1630-1639); L-10, 34 ft. (A-1662), 30 ft.–28 ft. (A-1664-1666), 22 ft. (A-1670), 19 ft.–17 ft. (A-1672-1674), 13 ft.–4 ft. (A-1676-1683), recent core Deevey and Hutchinson (A-1688).

AMPHORA Ehrenberg

Amphora ovalis (Kutz.) Kützing

Amphora ovalis (Kütz) Kützing, 1844, Bacill., p. 107, pl. 5, fig. 35.

Frustulia ovalis Kützing, 1834, Linnaea, vol. 8, pl. 13, fig. 5, p. 539.

Linsley Pond: L-10, 10 ft.–6 ft. (A-1679-1682), recent core Deevey and Hutchinson (A-1686); L-9, 14 ft. (A-1699), recent core Deevey and Hutchinson (A-1707); L-2, 14 ft. (A-1714).

Amphora ovalis var. **affinis** (Kütz.) Van Heurck

Amphora ovalis var. *affinis* (Kütz.) Van Heurck, 1880, Syn. Diat. Belgique, pl. 1, fig. 2, text (1885), p. 59.

Amphora affinis Kützing, 1844, Bacill., p. 107, pl. 30, fig. 66.

This variety is well distributed through all the profiles of Linsley Pond.

Linsley Pond: L-1A, 13 ft. – 5 ft. (A-1625-1642); L-10, 40 ft. – 3 ft. (A-1657-1684), recent core Deevey and Hutchinson (A-1687, 1688); L-9, 22 ft. – 20 ft. (A-1693-1695), 18 ft. – 2 ft. (A-1696-1705), recent core Deevey and Hutchinson (A-1706, 1707); L-2, 14 ft. – 8 ft. (A-1714-1718); recent core in 9.5 m. water Hutchinson (A-1721, 1723).

Amphora perpusilla Grunow

Amphora perpusilla Grunow, 1884, Denk. Akad. Wiss. Wien, vol. 48, p. 50, pl. 1, fig. 6.

Linsley Pond: L-10, 38 ft. (A-1658), 34 ft. (A-1662), 30 ft. (A-1664), 17 ft. (A-1674), 13 ft. (A-1676), 12 ft. (A-1678), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1686, 1687); L-9, 21 ft. (A-1694), recent core Deevey and Hutchinson (A-1707).

CYSTOPLEURACEAE

Since *Epithemia* is a later homonym and the name *Cystopleura* has to be adopted, it seems best to change the family name to fit the typical genus.

CYSTOPLEURA Brébisson emend. O. Kuntze

The species of this genus are usually littoral forms, occurring in fresh water with a more or less high mineral content.

Cystopleura argus var. **alpestris** (W. Sm.) De-Toni

Cystopleura argus var. *alpestris* (W. Sm.) De-Toni, 1892, Sylloge Algarum, Bacill., p. 783.
Epithemia alpestris W. Smith, 1853, Brit. Diat., vol. 1, p. 13, pl. 1, fig. 7.

Linsley Pond: L-10, 36 ft. (A-1660), 30 ft. – 26 ft. (A-1664-1668), 20 ft. (A-1671), 17 ft. – 10 ft. (A-1674-1679), 8 ft. – 6 ft. (A-1681-1682), 3 ft. (A-1684); L-2, 13 ft. (A-1715).

Cystopleura sorex (Kütz.) Kuntze

Cystopleura sorex (Kütz.) Kuntze, 1891, Revis. Gen. Plantar., vol. 2, p. 891.
Epithemia sorex Kützing, 1844, Bacill., p. 33, pl. 5, fig. 12.

Linsley Pond: L-9, 23 ft. (A-1692), 21 ft. (A-1694).

Cystopleura turgida (Ehr.) Kuntze

Cystopleura turgida (Ehr.) Kuntze, 1891, Revis. Gen. Plantar., vol. 2, p. 891.
Navicula turgida Ehrenberg, 1832, Abhandl. Akad. Wiss. Berlin, 1830, p. 64.

This species is often found in fresh water which is rich in calcium.

Linsley Pond: L-1A, 15 ft. (A-1622), 12 ft. (A-1628), 11 ft. (A-1630), 9 ft. (A-1635), 7 ft. (A-1639), 3 ft. (A-1646), 1 ft. (A-1648); L-10, 38 ft. (A-1658), 32 ft. (A-1663), 26 ft. – 20 ft. (A-1668-1671), 15 ft. – 10 ft. (A-1675-1679), 8 ft. – 4 ft. (A-1681-1683), recent core Deevey and Hutchinson (A-1686-1688); L-9, 6 ft. – 2 ft. (A-1703-1705), recent core Deevey and Hutchinson (A-1706, 1707); L-2, 16 ft. (A-1712), 6 ft. (A-1719); recent core in 9.5 m. water Hutchinson (A-1721, 1723).

Cystopleura turgida var. **granulata** (Ehr.) Brun.

Cystopleura turgida var. *granulata* (Ehr.) Brun., 1880, Diat. des Alpes et du Jura, p. 44, pl. 2, fig. 13.
Eunotia granulata Ehrenberg, 1836, Poggendorff's Ann. Phys., 1836, p. 220, pl. 4, fig. 2.

Linsley Pond: L-1A, 15 ft. (A-1620), 13 ft. (A-1625), 12 ft. (A-1629), 9 ft. – 7 ft. (A-1635-1639), shallow water November 1941 Patrick (A-1650); L-10, 38 ft. (A-1658), 34 ft. – 26 ft. (A-1662-1668), 22 ft. – 19 ft. (A-1670-1672), 13 ft. (A-1676), 10 ft. (A-1679), 8 ft. – 6 ft. (A-1681-1682), 3 ft. (A-1684); L-9, 12 ft. (A-1700), 2 ft. (A-1705).

Cystopleura zebra (Ehr.) Kuntze

Cystopleura zebra (Ehr.) Kuntze, 1891, Revis. Gen. Plantar., vol. 2, p. 891.
Navicula (Surirella) zebra Ehrenberg, 1835, Abhandl. Akad. Wiss. Berlin, 1833, p. 262.

Linsley Pond: L-10, 34 ft. (A-1662), 30 ft. – 20 ft. (A-1664-1671), 17 ft. (A-1674), 9 ft. (A-1680), 3 ft. (A-1684); L-9, 2 ft. (A-1705); L-2, 14 ft. (A-1714).

Cystopleura zebra var. **porcellus** (Kütz.) De-Toni

Cystopleura zebra var. *porcellus* (Kütz.) De-Toni, 1892, Sylloge Algarum, Bacill., p. 785.
Epithemia porcellus Kützing, 1844, Bacill., p. 34, pl. 5, figs. 17, 19.

Linsley Pond: L-1A, 15 ft. (A-1622), 10 ft. (A-1633), 9 ft. (A-1635); L-10, 26 ft. (A-1668), 22 ft. – 19 ft. (A-1670-1672), 15 ft. – 6 ft. (A-1675-1682), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1686).

Cystopleura zebra var. **proboscidea** (Kütz.) De-Toni

Cystopleura zebra var. *proboscidea* (Kütz.) De-Toni, 1892, Sylloge Algarum, Bacill., p. 784.
Epithemia proboscidea Kützing, 1844, Bacill., p. 35, pl. 15, fig. 13.

Linsley Pond: L-1A, 7 ft. (A-1639).

Cystopleura zebra var. **saxonica** (Kütz.) De-Toni

Cystopleura zebra var. *saxonica* (Kütz.) De-Toni, 1892, Sylloge Algarum, Bacill., p. 784.
Epithemia saxonica Kützing, 1844, Bacill., p. 35, pl. 5, fig. 15.

Linsley Pond: L-1A, 10 ft. – 8 ft. (A-1633-1638), shallow water November 1941 Patrick (A-1652); L-10, recent core Deevey and Hutchinson (A-1688); L-9, recent core Deevey and Hutchinson (A-1708).

RHOPALODIA O. Müller

Rhopalodia gibba (Ehr.) Müller

Rhopalodia gibba (Ehr.) Müller, 1897, Engler's Bot. Jahrb., vol. 22, p. 65, pl. 1, figs. 15-17.
Navicula gibba Ehrenberg, 1832, Abhandl. Akad. Wiss. Berlin, 1831, p. 80. This name was first applied to this species by Ehrenberg in 1831, Abhandl. Akad. Wiss. Berlin, 1830, p. 64, but the description was not given till the above citation.

Linsley Pond: L-1A, 1 ft. (A-1650), shallow water November 1941 Patrick (A-1652); L-10, 38 ft. (A-1658), 34 ft. – 3 ft. (A-1662-1684), recent core Deevey and Hutchinson (A-1686-1688); L-9, recent core Deevey and Hutchinson (A-1707); recent core in 9.5 m. water Hutchinson (A-1722).

NITZSCHIACEAE

NITZSCHIA Hassall

Nitzschia amphibia Grunow

Nitzschia amphibia Grunow, 1862, Verh. Zool. Bot. Ges. Wien, vol. 12, p. 574, pl. 12, fig. 23.

Linsley Pond: L-10, 22 ft. (A-1670), 15 ft. – 13 ft. (A-1675-1676), recent core Deevey and Hutchinson (A-1686, 1687).

Nitzschia Denticula Grunow apud Cleve and Grunow

Nitzschia Denticula Grunow apud Cleve and Grunow, 1880, Sv. Vet. Akad. Handl., vol. 17, no. 2, p. 492, fig. 68.

This species is present in several of the profiles, though not frequent at any level. It is found most often in L-1A.

Linsley Pond: L-1A, 15 ft. (A-1620), 13 ft. (A-1625), 12 ft. (A-1628), 10 ft. – 6 ft. (A-1633-1640); L-10, 38 ft. (A-1658), 34 ft. – 32 ft. (A-1662-1663), 28 ft. – 20 ft. (A-1666-1671), 12 ft. (A-1678), 8 ft. (A-1681), recent core Deevey and Hutchinson (A-1687); L-9, 22 ft. – 21 ft. (A-1693-1694), 18 ft. (A-1696), 16 ft. (A-1698); L-2, 14 ft. (A-1714).

Nitzschia paxillifera (O. F. Müller) Heiberg

Nitzschia paxillifera (O. F. Müller) Heiberg, 1863, Consp. Crit. Diat. Danicarum, p. 113.
Vibrio paxillifer O. F. Müller, 1786, Animalcul. Infus., p. 54, pl. 7, figs. 3-7.

Linsley Pond: L-10, recent core Deevey and Hutchinson (A-1687).

SURIRELLACEAE

SURIRELLA Turpin

Surirella angusta Kützing

Surirella angusta Kützing, 1844, Bacill., p. 61, pl. 30, fig. 52.

Linsley Pond: L-10, recent core Deevey and Hutchinson (A-1686-1688), plankton May 1938 Riley (A-1596), plankton January 1938 Riley (A-1597); L-9, recent core Deevey and Hutchinson (A-1707-1708); recent core in 9.5 m. water Hutchinson (A-1724, 1725).

Surirella biseriata Brébisson

Surirella biseriata Brébisson, 1836, Mem. Soc. Acad. Sci., Artes, Belles Lettres de Falaise, 1835, p. 53, pl. 7.

Linsley Pond: L-9, recent core Deevey and Hutchinson (A-1707).

Surirella linearis var. **constricta** Grunow

Surirella linearis var. *constricta* Grunow, 1862, Verh. Zool. Bot. Ges. Wien, vol. 12, p. 455.

Linsley Pond: L-10, 32 ft. (A-1663), 28 ft. – 19 ft. (A-1666-1672), 3 ft. (A-1684), recent core Deevey and Hutchinson (A-1687); recent core in 9.5 m. water Hutchinson (A-1721-1724).

Surirella spiralis Kützing

Surirella spiralis Kützing, 1844, Bacill., p. 60, pl. 3, fig. 64.

This species though plentiful at the level given below, is quite broken. It is doubtful if it lived in the lake. It is usually found in northern or cool water.

Linsley Pond: L-9, 16 ft. (A-1698).

CAMPYLODISCUS Ehrenberg

Campylodiscus noricus Werneck ex Ehrenberg

Campylodiscus noricus Werneck ex Ehrenberg, 1840, Berichte Akad. Wiss. Berlin, 1840, p. 205.

C. noricus is typically found in northern or cool regions. The remains of this species are often badly broken.

Linsley Pond: L-9, 19 ft. – 14 ft. (A-1695b-1699), 6 ft. (A-1703), 2 ft. (A-1705); L2, 14 ft. (A-1714), 13 ft. (A-1715).

CYMATOPLEURA W. Smith

Cymatopleura solea (Bréb.) W. Smith

Cymatopleura solea (Bréb.) W. Smith, 1861, Ann. and Mag. Nat. Hist., 1861, p. 12, pl. 3, fig. 9.

Surirella solea Brébisson, 1838, Consid. sur les Diat., p. 17.

Linsley Pond: L-10, 26 ft. – 20 ft. (A-1668-1671), 15 ft. – 13 ft. (A-1675-1676), 6 ft. – 3 ft. (A-1682-1684), recent core Deevey and Hutchinson (A-1688).

DISCUSSION

In this study of the profiles of Linsley Pond some experimentation was done in methods of study. Slides were prepared in two ways. For the study of frequency of the more common species, the slides were carefully prepared from a quantitative standpoint. In this method a standard dilution factor was used, which as a natural result in some cases would produce very thin slides. I therefore found it necessary, in determining whether a flora consisted of only a very few species or a few common species and many much less frequent forms, to study either several slides prepared in this manner or to supplement my quantitative slides with ones made from dilutions in proportion to the residual sediments. In working with diatoms, it often happens that though one starts out with the same amount of sediment volumetrically, the end results after cleaning by the acid method are very different.

In this type of study we are mainly interested in the diatoms from the standpoint of what they can tell us about the water conditions of the lake. It is, therefore, in those species which lived successfully in the lake that we are most interested. Several species of diatoms were of rare occurrence;

that is, they were found only once or twice in a given level of a single profile or they occurred only rarely in several levels. Just what these rare species represent is hard to say. They may be contaminations from other lakes brought in by wind or birds. However, they might be species which lived more or less successfully in parts of the lake not transected by the profiles.

In this connection it is interesting to note to what extent diatoms, living in the lake waters at the same time, did mix. For instance *Melosira ambigua* was abundant in the profile L-10 from the 24 ft. level to recent times, yet we find no evidence of it in L-1A and only recently in L-9. Likewise *Stephanodiscus astraea* which was frequent or abundant in L-10 from 28 ft. to 17 ft. is only rarely, if at all, found in L-9 and L-1A in the corresponding levels. However, there is evidence that there has been some mixing of shallow water forms with those of deeper waters. It is hard to tell whether this occurred while the diatoms were living or after the sediments were formed. Take for instance *Fragilaria construens* which is usually a shallow water form though it may occur in plankton. In the corresponding levels, when it is frequent or abundant in L-1A and L-9, it is merely present in L-10. It would be difficult to say whether its presence in L-10 is due to mixing while living, actual adapting itself to plankton life, or mixing of the sediments after they were formed.

In the study of profile L-10, practically every specimen seen has been recorded. An extremely detailed study was made of this profile, to see if the single specimens recorded would reveal any facts which might not appear otherwise. These single specimen records, though they extend the range of the species in the profile, do not seem to add any new facts, so were not carried out in L-9 and L-1A. In the profiles L-9 and L-1A those specimens are recorded which have occurred two, three, or more times, but not single specimen records. In L-10 (Table I), I do not believe as a rule that the lack of the record of a species can mean that it absolutely did not occur, for it would be impossible to examine all the diatoms in a given sample. Of course in the levels at 30 ft. and 17 ft., where there seems to be an actual upset in the diatom flora, it is much more probable that the species did not occur.

This study of the diatoms found in the profiles of Linsley Pond has brought out and confirmed several interesting facts concerning the conditions which existed at the different stages in the development of the lake.

Of the profiles studied (L-10, L-9, L-1A, and L-2), L-10 showed the richest deposits of diatoms (Table I). In this profile the first diatom flora is found at 40 ft. The flora is relatively meager as to number of species. The abundant or frequent forms are *Cyclotella compta* var. *radiosa*, *Cyclotella ocellata, Cymbella similis,* and *Navicula dicephala*. In the flora from

40 ft. through 32 ft. the most abundant forms are *Cymbella similis* and *Cyclotella compta* var. *radiosa*. However, there is a steady increase in the diversity of species present, until at 32 ft. the flora shows a much greater diversity than at 40 ft. In addition the following forms are of frequent or better occurrence in one or more levels: *Amphora ovalis* var. *affinis, Cocconeis placentula, Cyclotella ocellata, C. operculata, Cymbella cistula, Eucocconeis flexella, Fragilaria construens, Gyrosigma attenuatum, Melosira ambigua, Navicula dicephala, Navicula radiosa, Neidium iridis,* and *Stauroneis phoenicenteron.*

At 30 ft. a disturbance of some kind occurred in the lake (Pl. 11, figs. 1, 2). It seems to have been prevalent throughout the lake, as evidence of it is also found in L-9 and L-1A. Noticeable is the lack of abundance of *Cyclotella compta* var. *radiosa*, which was so prevalent in the other layers. There seems to be a greater accumulation of broken fragments of diatoms. A true diatom flora, if present, is greatly diminished. However, the disturbance was not great enough to destroy the diatom flora. It must have been of temporary nature, for in the 28 ft. level we find the development of a eutrophic flora. This is truly a rich flora from both a quantitive and qualitative standpoint. The eutrophic diatoms (Hustedt, 1930), *Stephanodiscus astraea* and *Melosira ambigua* appear for the first time in considerable quantities. *Cyclotella compta* var. *radiosa* is also present in considerable numbers but it is not as prevalent as in the previous layers.

In the 28 ft. – 20 ft. levels many species which are usually shallow water or littoral forms are of frequent or better occurrence. Such species are *Cymbella angustata, C. cuspidata, C. Ehrenbergii, C. rupicola, C. ventricosa, Mastogloia Smithii* var. *lacustris, Navicula oblonga,* and *Neidium iridis.* At first it was difficult to explain the existence of littoral forms in the great depth of water which must have existed at this point during the 28 ft. stage. However, Kindle (1915) has shown that littoral forms may live at a depth of 150 ft. of water if the water is clear enough to supply necessary light. Dr. Rogick's findings (Deevey, 1941) of the statoblasts of *Plumatella*, which are generally epiphytic forms, at this level, also supports the theory that littoral vegetation grew formerly in much deeper water than at the present time. These conditions seem to have existed before the development of the rich *Melosira* flora, a typically planktonic flora. For with the development of the *Melosira* flora the abundance of epiphytic diatoms greatly decreases, beginning at the 22 ft. level. Thus the diatoms support the statement of Deevey that, "In other words, early in C-1 the most favorable balance of transparency, standing crop of phytoplankton, and littoral vegetation was attained, and any further increase in phytoplankton (at surface) was compensated by a decrease in the quantity of higher plants."

The well-developed planktonic flora in L-10 continues to the end of the profile. However, the best development is found previous to the 17 ft. level, where the occurrence of both debris and breakage is noticed. This disturbance is also observed in the other profiles. The cause of this breakage and debris is not known but seems to be widespread. Though the flora is not destroyed, it is certainly less abundant than in the previous layers. It is interesting to note (Deevey, 1942) that the greatest maximum of the cladoceran, *Bosmina*, occurs at 18 ft. in L-10. If its occurrence was widespread throughout the lake, it may well be that it was a contributing cause to the degeneration of the diatom flora at this level. From the 15 ft. level through the 4 ft. level *Cyclotella operculata* and *Melosira ambigua* are the common species. Also in these levels there is an increase in the occurrence of *Cyclotella compta* var. *radiosa*. However, the very favorable conditions for a diatom flora which existed between 28 ft. and 17 ft. do not seem to occur. At the 7 ft. level there is another slight interruption in the diatom flora, less serious than the previous ones. From this level through to 4 ft. level the flora is not as rich as in the levels just previous. The flora at the 4 ft. level is much better developed. *Melosira ambigua* is abundant. Of frequent or better occurrence are *Cocconeis placentula, Cyclotella compta* var. *radiosa, Cyclotella operculata, Cyclotella stelligèra, Cymbella cistula, Cymbella cuspidata, Eunotia formica, Melosira ambigua,* and *Navicula radiosa.*

In addition to the profile samples, Dr. Hutchinson and Dr. Deevey, by means of a Naumann tube sampler, obtained cores 63 centimeters long from the recent mud. These cores were divided roughly into three divisions which are designated as bottom, middle, and top. The top probably represents very recent diatom accumulations. The bottom and middle of the core taken at L-10 had flora very similar to that at 4 ft. and 3 ft. *Melosira ambigua* and *Cyclotella operculata* were the most common forms. The flora seemed to be poorer qualitatively though as rich quantitatively as at 3 ft.

However, the top of this core differs radically from that of the bottom or middle. *Melosira ambigua*, which was abundant in the previous layers, is greatly reduced, as is *Cyclotella operculata*. The flora is dominated by *Fragilaria crotonensis* and *Synedra acus* var. *angustissima*. Of frequent or better occurrence are *Asterionella formosa, Cocconeis placentula, Navicula radiosa, Synedra ulna* var. *danica*, and *S. ulna* var. *subaequalis*. Such a flora is very similar to the one now living in the lake. Recent plankton counts made by Dr. Hutchinson and Dr. Riley over a period from April 1937 to June 1938, show *Fragilaria crotonensis* with an average count of 500 per cubic centimeter, but it may reach 4000 per cubic centimeter during late July or August. This is the most abundant species. The next most

common species is *Synedra acus* var. *angustissima* with an average of 160 per cubic centimeter. It reaches its maximum development from February to May. Other species of frequent or better occurrence are *Asterionella formosa, Melosira ambigua, Melosira italica,* and *Stephanodiscus astraea.* Thus it would seem that some change must have occurred fairly recently in the ecological conditions of the water to bring about such a radical change in the dominant species.

The L-9 profile shows the same stages as L-10 (Table 2). As the deposition of sediments is not as great at this point, the actual length of the core is much less. As might be expected, the well-developed planktonic flora found in L-10 does not occur at this station, for it is in much shallower water.

The first diatom flora is found at 25 ft. The flora is poor qualitatively, but rich quantitatively. The commonest species are *Fragilaria construens, Fragilaria pinnata, Fragilaria brevistriata,* and *Cymbella similis* which is illustrated on Plate 12, figure 4. The flora became better developed and somewhat more diversified up to 19 ft. The frequent to common forms are *Amphora ovalis* var. *affinis, Cyclotella compta* var. *radiosa, Cymbella similis, Cymbella ventricosa, Fragilaria brevistriata, Fragilaria construens, Fragilaria leptostauron, Fragilaria laponica, Navicula protracta,* and *Navicula scutelloides.*

At the 19 ft. level (Pl. 11, figs. 3, 4) we find the same type of breakage and general interruption of the diatom flora as was found in L-10 at 30 ft. As in L-10, the disruption was only temporary, for at 18 ft. we find developed a benthic flora which has as the common or frequent species *Campylodiscus noricus, Cyclotella compta* var. *radiosa, Fragilaria brevistriata, Fragilaria construens, Mastogloia Smithii* var. *lacustris,* and *Navicula protracta.* From the 18 ft. level through the 10 ft. level the flora is fairly well diversified as to species. During this period other species than the forementioned which reach frequent occurrence are *Cymbella Ehrenbergii, Fragilaria pinnata, Navicula graciloides,* and *Opephora Martyi.* Though the flora is not nearly as well developed as at L-10, it is definitely present. At the 9 ft. level the same type of breakage and disruption of the diatom flora is noted as was seen at 17 ft. in L-10. It is not until the 4 ft. level that a well-developed flora is again obtained. At this level the flora is definitely richer qualitatively, though no one species could be considered dominant from a quantitative standpoint. *Melosira ambigua* has for the first time become a part of the flora in this profile.

In the study of the core from recent mud taken by Dr. Hutchinson and Dr. Deevey at this station, the bottom layer shows a flora very similar to that of 4 ft. The species of frequent occurrence are *Amphora ovalis* var. *affinis, Fragilaria construens,* and *Navicula protracta.* The middle layer is

dominated by *Melosira ambigua*, while the top resembles the top of the recent core taken at L-10, in the great reduction in frequency of *Melosira ambigua*. The species of frequent occurrence are *Cocconeis placentula, Cyclotella operculata, Cymbella cistula*, and *Synedra acus* var. *angustissima*.

The L-1A profile is typically a shallow-water profile (Table III). As might well be expected, there is more silt and inorganic debris than in the other profiles. However, it shows the same major changes as seen in L-9 and L-10. The flora, first found at 15 ft., is throughout the profile, typically benthic. It is initially dominated by the genus *Fragilaria*, particularly the species *Fragilaria pinnata; Fragilaria brevistriata* and *Fragilaria construens* are also of frequent occurrence. At 14 ft. *Cymbella similis* (Pl. 12, figs. 1, 4) is the only common species. As in the other profiles, the flora is at first poor qualitatively but rich quantitatively, but increases in number of species throughout 11 ft. The frequent and common forms in these levels are *Cyclotella compta* var. *radiosa, Cymbella Ehrenbergii, Cymbella similis, Cymbella ventricosa, Eucocconeis flexella, Eunotia pectinalis* var. *minor, Fragilaria brevistriata, Fragilaria construens, Fragilaris construens* var. *binodis, Fragilaria pinnata, Mastogloia Smithii* var. *lacustris*, and *Navicula protracta*. At 10 ft. there seems to be quite a bit of breakage as seen at 30 ft. in L-10 and 17 ft. in L-9 (Pl. 12, figs. 3, 2). At 9 ft. the flora begins to improve and at 8 ft. a well-developed flora of typically benthic forms is present. The frequent and abundant forms are *Amphora ovalis* var. *affinis, Cymbella aspera, Cymbella cistula, Cymbella cuspidata, Cymbella Ehrenbergii, Cymbella rupicola, Cystopleura turgida* var. *granulata, Fragilaria construens, Fragilaria pinnata, Mastogloia Smithii* var. *lacustris, Navicula oblonga, Navicula protracta, Navicula tuscula, Opephora Martyi, Pinnularia maior, Pinnularia viridis*, and *Stauroneis phoenicenteron*. The flora varies somewhat but remains rich till 5 ft. At the 5 ft. level the flora begins to deteriorate and is finally blotted out at 2 ft. The 2 ft. level seems to correspond with the 17 ft. level of L-10 and the 9 ft. level of L-9. The flora is somewhat richer at the 1 ft. level but still rather poor. A great deal of silt and fine sand are present, many of the diatom valves are broken. The only frequent forms are *Cocconeis placentula, Eunotia formica*, and *Eunotia pectinalis* var. *minor*. The present-day benthic flora was also studied. It was obtained by collecting surface debris and squeezing from leaves and other debris. The frequent species were found to be *Cocconeis placentula, Cystopleura turgida* var. *granulata, Cystopleura zebra* var. *saxonica*, and *Rhopalodia gibba*. Of course one must keep in mind that these collections represent only a portion of the benthic flora. Nevertheless it shows that at this profile, as well as at L-9 and L-10, the present-day flora is quite different from that which existed in the past.

The profile L-2 was very difficult to correlate from a limnological standpoint. The succession of development, though generally the same, could not be well correlated with the other profiles. This was probably due to the fact it is near one of the inlets, and diatom shells brought in from other regions were deposited in this general location.

Thus the development of the diatom flora of Linsley Pond supports and emphasizes several interesting conclusions. The lake at first had a diatom flora consisting of relatively few species. (See Tables I, II, III.) As the nutrients available in the lake became more abundant, the flora became more diversified. Some species, such as *Cyclotella ocellata, Cymbella similis, Fragilaria leptostauron,* and *Fragilaria laponica* decreased or disappeared, while others probably not so specific as to nutriment requirements, persisted. Still others such as *Melosira ambigua* and *Stephanodiscus astraea,* which are more commonly found in entrophic waters, appear in great abundance for the first time. The abundance of typically benthic diatoms at the 28-26 ft. levels of L-10 would indicate, as do the *Plumatella* statoblasts (Deevey, 1941), that the littoral vegetation once grew at a much greater depth than to-day. Thus the water in late-oligotrophic – early-eutrophic times must have been much clearer than now. With the coming of a well-developed plankton flora, as evidenced by the abundance of *Melosira ambigua,* these epiphytic and benthic forms disappear as an important element in the flora. Their mere presence is probably due to specimens, living or dead, mixed in from the shallower water. From the diatom evidence it would appear that the lake became eutrophic in the early part of C-1. This supports the conclusion of other workers (Hutchinson and Wollack, 1940; Deevey, 1941. Once having become eutrophic, the lake remained eutrophic to present times. However, during this period there were times which were much more favorable to diatom growth than others, the most favorable time in the lake history for diatom growth being the period from the early part of C_1 to the early part of C_2. During the following period environment factors did not seem to be so favorable. However, toward the end of the profile, end of C_3, the diatom flora is much better developed and many of the species reappear which were present in the early part of C_1.

As pointed out in the previous discussion, there are two levels in the development of the lake which were very unfavorable to diatom growth. The first period occurred at 30 ft. in L-10, 19 ft. in L-9, and 10 ft. in L-1A. The second period occurred at 17 ft. in L-10, 9 ft. in L-9, and 2 ft. in L-1A. Dr. Bradley, United States Geological Survey, has examined these profiles for change in type of sedimentation and for the presence of volcanic ash. He was not able to correlate the sediments from L-1A with those from L-9, and L-10. Quoting directly from the letter concerning profiles L-9 and L-10:

"I have examined under a petrographic microscope your slides prepared from Hutchinson and Deevey's profiles L-10 and L-9 taken from the bottom deposits of Linsley's Pond. I found no trace of volcanic ash in either series. The inorganic constituents are particles of normal clastic sediment; quartz, feldspar, and clay minerals. These range in size from clay-size (2 microns or less in diameter) through silt-size (2 to 20 microns) to sand size (greater than 20 microns). In the sediment from depths of 9 and 19 ft. in profile L-9 there is a considerable abundance of fine sand but in sediment from the 19 ft. level there is also much silt and clay-sized material. At depths of 16 ft. and 30 ft. in the L-10 profile the sediments are analogous to the two clastic layers in the L-9 profile. The upper one consists largely of clean fine sand whereas the lower one contains an abundance of silt-sized clastic material also. The similarity of these pairs of clastic layers suggest that they can be used to correlate the profiles. Perhaps the changes in the diatom floras above and below either or both these layers also correspond in the two profiles. If so, that would reinforce the correlation.

"So far as I know these layers of clastic sediment in the Linsley's Pond deposits only indicate temporarily accelerated erosion of the surrounding terrain. That acceleration may have been produced by a variety of causes such as stream piracy, exceptional floods following protracted drought, or forest fires, as Hutchinson has suggested. There may be other causes too and I see no way of choosing between the various possible causes.

"There remains the possibility that a thin layer of volcanic ash is actually present in the Linsley's Pond sediments but that it comes between the samples prepared for the study of the diatoms."

Thus assuming that these two major disturbances affected all the profiles of the lake at the same time, that a diatom flora first appeared in the different profiles about the same time, and that the diatom flora first became eutrophic in all parts of the lake at about the same time, then it seems that the limits of the periods A_1, A_2, B_1, C_1, C_2, C_3, as suggested by Deevey from the pollen profile, need to be changed slightly. The suggested limits for these periods as shown in the above studies are set forth in Table IV.

The temperature of the lake water always seems to have been favorable to growth, since the advent of the diatom flora. The pH of the lake seems to have been always more or less the same; there is no evidence of a very acid or very alkaline water flora at any time in the history of the lake. Those species of the genus *Eunotia* which are typically calciophobes and prefer more or less acid water never became an important element.

From the examination of the most recent sediments, it would appear that a change in the ecological condition of the lake has occurred in the immediate past. The bottom of the Naumann tube samples shows a flora similar to that which existed in the lake since the early part of C_1. The abundant and frequent species are *Amphora ovalis* var. *affinis*, *Cyclotella operculata*, *Cyclotella stelligera*, *Fragilaria construens*, *Melosira ambigua*, and *Navicula protracta*. The middle of the Naumann tube sample shows

a transitional stage, while the top contains a very different flora. In the top of the sample the common or frequent forms are *Asterionella formosa, Cocconeis placentula, Cyclotella operculata, Cymbella cistula, Fragilaria crotonensis, Synedra acus* var. *angustissima, Synedra ulna* var. *danica,* and *Synedra ulna* var. *subaequalis.* Most interesting is the lack of abundance of *Melosira ambigua* which had been the most consistently important species since the 28 ft. level. In its place we find *Fragilaria crotonensis* and *Synedra acus* var. *angustissima* as the most abundant forms. In this respect the present-day plankton resembles very much the top of the Naumann tube sample. However, *Melosira ambigua* is to-day again more numerous, and *Asterionella formosa, Cyclotella glomerata,* and *Melosira italica* are abundant in the lake for the first time.

These recent changes, as suggested by Dr. Hutchinson, may be more or less due to the use of part of the drainage basin of the lake for agricultural purposes.[2]

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[2] Samples of mud from the bottom, middle, and top of one Naumann tube sample (9.5 m.), showing the type of change in diatom flora that Dr. Patrick has described, were dried and the organic matter, determined by ignition, was found to be 63.5%, 55.9% and 28.4% of the dry matter, respectively. The change in the diatom flora therefore is concomitant with the increase in the rate of inorganic silting, attributed by Hutchinson and Wollack to the disturbance of the original vegetation cover of the basin.—*G. E. Hutchinson.*

TABLE 1—L-10

Symbols: Rare— — Present— • Frequent— ⊙ Common or abundant— +

Periods (Deevey, emended)

A_1 | ←—A_2—→ | ←— C_1 —→ | ←—— C_2 ——→ | ←—— C_3 ——→

Depth in feet

	40	38	36	34	32	30	28	26	24	22	20	19	17	15	13	12	10	9	8	6	4	3	B*	M*	T*	P†
Achnanthes exigua			•				⊙		•	•	•	•	•	•	•	—	•	•	⊙	•	•	⊙	•	•		
A. lanceolata															—								•			•
A. lanceolata v. elliptica														—	•		—			—		—	—	•		
A. minutissima																										•
Amphora ovalis																	•	•	•	•			•			
A. ovalis v. affinis	•	•	•	⊙	⊙	•	⊙	•	•	⊙	•	•	•	•	⊙	•	⊙	•	⊙	—	•	•		•	•	
A. perpusilla		—		—		—							—		—	—						—	—	⊙		
Asterionella formosa																							•	•	⊙	+
Caloneis bacillum											—	—	—										•			
C. trinodis										—			—		•	—					•	•	•			
C. silicula									•	•	•				•	•	•		•	•	•	•				
Cocconeis placentula				•	⊙	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	⊙	⊙	•	•	⊙	
Cyclotella compta v. radiosa.	+	+	+	⊙	+	•	+	•	+	+	•	⊙	•	•	+	⊙	•	⊙	⊙		+	⊙	•	•		
C. glomerata							•																			⊙
C. ocellata	⊙	⊙	•	⊙	•		•																•			
C. operculata				⊙	⊙		+	⊙	+	⊙	⊙	⊙	⊙	+	+	⊙	⊙	⊙	+	+	⊙	⊙	⊙	⊙	•	•
C. stelligera					•		•	⊙	•	•	•	•	•	•	•	•	•	•	•	•	•	⊙	⊙	•	•	•
Cymatopleura solea								•	•	•	•			•	—					—	•	•			•	
Cymbella affinis		•	•	•	•		•	•	•		•			•	•						.	—		•		
C. amphicephala				—	—	—	•	•	•		•	•		—	—	•	—	—	—	—		—			—	
C. angustata							•	+	⊙	•	•	•		—	•				•		—			•		
C. aspera				•	•					•	•	•	•	•	•	•	•	•	•	•	•	•	•	—	•	
C. Cesatii							•		•	•	•				—							•				
C. cistula	•	•		⊙	•		⊙	⊙	•	⊙	•	⊙	•	⊙	•	•	•	•	•	•	⊙	⊙	•	•	•	
C. cuspidata		•		—	—			•	⊙	•	•	•	•	•	•	•	•	•	•	•	⊙	⊙	•	•		
C. delicatula			•					•		•	•															
C. Ehrenbergii		•		•	•	•	•	⊙	⊙	•	•	•	•	—	•											

TABLE I—L-10 (continued)

	Depth in feet																									
	40	38	36	34	32	30	28	26	24	22	20	19	17	15	13	12	10	9	8	6	4	3	B	M	T	P
C. hybrida					•																					
Cymbella naviculiformis		•		—			•	•		•			•	•	•							—				
C. rupicola		•	•		•	—	•	⊙	•	•	•				—									•		
C. scotica					•	•			•		•	•	—	—	—	—	—	•	—		—	—	—	—		
C. similis	⊙	+	⊙	•											•				—							
C. turgida				—			•	•					•		•	•				—						
C. ventricosa		•				•	⊙	⊙	•	•	•	•		•	•	•	•	•	•	•		•	•	•		
Cystopleura argus v. alpestris			•			—	•	•			•		•	—	—	—	—		—	—		—				
C. turgida		•			•			•	•	•	•			•	•	—	—		—	•	—		•	•	•	
C. turgida v. granulata		—		•	•	•	—	•		⊙	•	•			—		•		—	•		—				
C. zebra				—		•	•	•	•	•	•		•					•				•				
C. zebra v. porcellus								•		•	•	•		•	•	•	•	•	•	—		•	•			
C. zebra v. saxonica																									•	
Diploneis marginestriata																—						—	•			
D. ovalis				•		•	•	—		•	•		—	—	•	•	•	•	•	•	•	•	•	•		
D. Smithii								•	•	—		—	•	•	•	•	•	•	•	•	•	—	•	•		
Eucocconeis flexella		—	•	⊙	•	•	•	•	—	—	•				—									•		
Eunotia arcus			—	—	—	•	•	•		•	—	—		•	•	•									•	
E. arcus v. bidens					—										—			—								
E. arcus v. fallax		—					—			•		•		—	—		—									
E. diodon		—		—	—			—		—	—			•	•											
E. flexuosa																		•								
E. formica				—		•	•	•	•	•	•		•	•	⊙	•	•	•	•	•	⊙	•	—	•	—	
E. gracilis		—		—	—		—	—	—	•	•						—			—						
E. lunaris				—	•		•	⊙	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•	
E. monodon														—	•	•	—	•	•	•						
E. monodon v. maior							—		—	—			•		•		—	—	—	—	•	—	—	—		
E. pectinalis														—	—	•	•		•		—					
E. pectinalis v. minor							•	•	•					•	•	—	—	•					•	—	—	•
E. pectinalis v. minor f. impressa			•		•				•		—	—	—	•	•	•	—	•	•	•	•		•	•	—	

TABLE I—L-10 (continued)

	Depth in feet																								
	40	38	36	34	32	30	28	26	24	22	20	19	17	15	13	12	10	9	8	6	4	3	3	M	T	P
E. pectinalis v. ventralis											—		—	•	•	—	—	•	—	—	•	•				
Eunotia praerupta							•																			
E. veneris											•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	
Fragilaria brevistriata	•	•	•		•	•	•	•	•	—	—		—	•	•	•		—								
F. capucina v. mesolepta ...																									•	
F. construens	•	•	•	⊙	•	•	•	•	•	•	•	•	•	•	•	•	•	⊙	⊙	•	•	•	•	•		
F. construens v. binodis			•	•						—					—								—			
F. crotonensis				•							⊙	•					⊙	•	•	•			•	•	+	+
F. leptostauron	•	—	—	—									—		—		•		—						—	
F. parasitica				—			—	•					•	—	•	•			—		—	•	•	•	•	
F. pinnata	•		•	—		—		•		•	•		•	•	•	•	•	•	•	•	•	•	•	•		
F. Vaucheriae			•		•		•	⊙	•	•	•	•		—	•	•		•	•	•		—	•	•	•	
F. virescens																•										
Gomphonema acuminatum ..										—					•	•	•	—		—			•	•	•	
G. acuminatum v. coronata..		•	•	•	•	•	•	•	•	•	•	⊙	•	⊙	○	⊙	⊙	•	•	⊙	—	•	—	—	—	
G. acuminatum v. pusilla ...				•			•	•			•				•	•	•		•	•		•			•	
G. angustata																							•	•	•	
G. augur										—			—		—	—	—	•	•			—	•	—		
G. constrictum				—	•		•	•	•	—	—	•	•	—	•	•	—		•		—	—	—	—	•	
G. constrictum v. capitata ..							—			•			—	—	•	•			—	—	—	—	—	—		
G. intricatum v. pumila			—		—		•	•	•	•	•		—	•	•	•			•		—	—	•	—	—	
G. sphaerophorum		—												•			—								•	
G. subtile v. sagitta				—		—	•			—		—	—		•	—	—	•	•	—	—				•	
Gyrosigma acuminatum											—				—	•	—	—	—	—		•	—			
G. attenuatum				⊙	•		•	•	—	•		•	—	—	•	•		⊙	•		•	•	—		•	
Mastogloia Grevillei		•		•	—			—																		
M. Smithii v. lacustris		•	•	•	•	⊙	○	⊙	•		•		—		•	—		—	•				—			
Melosira ambigua	⊙	⊙		•	•		⊙	⊙	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	•	+
M. italica																										+
M. italica v. tenuis																										•
Meridion circulare											—		—		—	—	•		—			—		•	•	

TABLE I—L-10 (continued)

	Depth in feet																								
	40	38	36	34	32	30	28	26	24	22	20	19	17	15	13	12	10	9	8	6	4	3	B	M	T	P
Navicula anglica																			•							
N. bacillum			•	•		—			—				—				—		—	—		—				
N. cincta v. Heufleri						—			•										—				•	•		
N. cuspidata				—	•		•	•	•	•	•	•	—	—	•	—	•		—	—	—	—		—	•	
N. dicephala	⊙			•	⊙	•	•	⊙	•	•	•	•			•	•	•		•	—	•	•	—	•		
N. exigua				—			—						—		—	—		—			—	•		•	—	
N. graciloides	•	•	•	•	•		⊙	•	•	•	•	•	•	•	•	•	•	—	•		•	—	•	•		
N. oblonga		•	•	•	⊙	•	•	⊙	⊙	⊙	•	•	•		—	—	•	•	—	•	—	•	•	•		
N. peregrina		•	•	•	•		•	•	•	⊙	•	•	—		•	—		—	•					•		
N. protracta		•	•	•	—	•	•	•	•	—	•	—	—	•	•	⊙	⊙	•	—	—	•	•	—	•		
N. pupula v. capitata		—					•	⊙	•	•	—	•	—	•		•			—			—	•	—	—	
N. pupula v. rectangularis ..					—		•	•	•	•	•	•		•	•	•	•	•	•			—	•	•		
N. radiosa		•	•	⊙	⊙	•	⊙	⊙	⊙	⊙	⊙	⊙	•	⊙	•	⊙	⊙	⊙	⊙	•	•	⊙	•	•	⊙	•
N. radiosa v. tenella			•		—	—	•	•	•	•	•	•			—	•	•		•			—	•	•	•	
N. Reinhardtii		—	—	—	•			—	—	—					•	—			—				—	—	•	
N. Schonfeldii																								•		
N. scutelloides			•		•	⊙	—	•	•	—	•		—		—								—	•		
N. tuscula	•	•	•	•	•	•	•	•	•		•		•	•	•	•	•	•	—	•	•	•	•	•	•	
Neidium affine				—			—	•	•	•	•	—			—	—				—		—	—			
N. Hitchcockii					—			•		—	—					•	•		—			•				
N. iridis		•	•	•	⊙	•	•	•	•	⊙	•	•	•			•				—	—	—				
Nitzschia amphibia										—				•	—									•	•	
Nitzschia Denticula		•		•	—		•	•	—	—	•					—			—						—	
N. paxilifera																								•		
Opephora Martyi					•	—	—	•	•	•	•		—	•	•	•		—	•	—				•	•	
Pinnularia acrosphaeria																•			—							
P. bihastata											•	•	—				—					—				
P. Braunii		•		•															•							
P. hemiptera					—		•	•			—		—		—	—										
P. interrupta		•																								
Pinnularia maior		—			•			•	•	•	•		—						—			—				

TABLE I—L-10 (continued)

	Depth in feet																								
	40	38	36	34	32	30	28	26	24	22	20	19	17	15	13	12	10	9	8	6	4	3	B	M	T	P
P. mesogongyla											•					•	•									
P. mesolepta							•																			
P. microstauron								•	•	•	—															
P. nobilis																•				•				•		
P. nodosa				•			•	•		•			•							•						
P. stauroptera							•			•					—	•	—			•	—	—	•			
P. stomatophora							•	•								—										
P. viridis				•		•		•		—	•	•		•	—	•	•		—	•	—	—	•			
Rhizosolenia eriensis																										•
Rhopalodia gibba		•		•	•	—	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	⊙	•	•	•	
Stauroneis acuta					—		•			•	•		•			•						—				
S. anceps				•	—		—	•							—		—					—	—		—	
S. phoenicenteron					⊙	—	•	•	•	•	•	•	—	—	•	•	—	•	—	•	•	—				
Stephanodiscus astraea					•	•	+	⊙	+	+	⊙	⊙	•	⊙	⊙	•	—	⊙	•	•	—	•	•	•	•	⊙
Surirella angusta																							•	•	•	•
S. linearis v. constricta					•		—	⊙	•	•	•	•										—		—		
Synedra acus																									•	
S. acus v. angustissima										•	⊙														+	+
S. amphicephala		—	—	—	•		•	•	•		—	—		—	—					•					•	
S. biceps											•	•														
S. capitata				•					—	•	•	•				•		•		•		•			•	
S. minuscula																										•
S. radians									—																	•
S. ulna									•																•	•
S. ulna v. danica								•	•	•	•				•	•		⊙			•	•			⊙	
S. ulna v. longissima									•	•					•											
S. ulna v. subaequalis										•											•	•			⊙	•
Tabellaria fenestrata			•	•	•		•	•		•	•			•	•	•		•			•	⊙	•	•	•	

* B, M, T — refer to the bottom, middle, and top of a Naumann Tube Sample
† P — refers to present-day plankton

TABLE II—L-9

Symbols: Rare— — Present— • Frequent— ⊙ Common or abundant— +

A_1 | ← A_2 → | ← C_1 → | ← C_2 → | ← C_3 →

Depth in feet

	25	24	23	22	21	20	19	18	17	16	14	12	10	9	8	6	4	2	B*	M*	T*
Achnanthes exigua					•				•	•	•	•					•	•	•	•	
A. lanceolata								•													
A. lanceolata v. elliptica					•									•						•	•
Amphiprora ornata																				•	
Amphora ovalis											•									•	
A. ovalis v. affinis				⊙	⊙	⊙		+	+	•	•	+	⊙	⊙	⊙	•	⊙	⊙	⊙	•	
A. perpusilla					•															•	
Asterionella formosa																					•
Caloneis silicula																	•				
Campylodiscus noricus							⊙	⊙	•	⊙	•					•		•			
Cocconeis placentula						•				•	•	•	•				•	•	•	•	⊙
Cyclotella compta v. radiosa		•	•	•	+	+		⊙	⊙				•		•		•				
C. operculata																		⊙		•	⊙
Cymbella aspera											•	•		•	•	•	•	•	•		
C. cistula					•	•		•			•	•	•		•	•		•		•	⊙
C. cuspidata				•	•			•			•	•	•						•		
C. Ehrenbergii						•		•	•	⊙	⊙	⊙	⊙	•	•	•	•				
C. scotica				•	•							•								•	
C. similis	+	+	+	+	⊙	•	•														
C. ventricosa	⊙		•		⊙	•					•	•	•			•		•	•	•	•
Cystopleura sorex			•		•																
C. turgida																•	•	•	•	•	
C. turgida v. granulata												•						•			
C. zebra																		•			

TABLE II—L-9 (continued)

	Depth in feet																				
	25	24	23	22	21	20	19	18	17	16	14	12	10	9	8	6	4	2	B	M	T
C. zebra v. saxonica																					•
Diploneis ovalis																		•	•	•	•
D. Smithii											•	•	•				•	•		•	
Eucocconeis flexella					•	•	•	•				•	•								
Eunotia arcus												•	•	•	•						
E. formica										•	•	•	•	•	•	•	•	•	•	•	•
E. gracilis												•									
E. lunaris																		•	•	•	•
E. monodon															•	•	•	•			
E. monodon v. maior																			•		
E. pectinalis													•								
E. pectinalis v. minor												•							•		
E. pectinalis v. minor f. impressa				•							•					•	•	•	•	•	•
E. veneris					•								•					•	•	•	•
Fragilaria brevistriata	⊙	⊙	•	⊙	•			⊙	•	•	•	⊙	⊙	⊙			•	•			
F. construens	+	+	⊙	+	⊙	+		⊙	⊙	•	⊙	+	+	⊙	•	•	•	•	⊙	•	•
F. construens v. binodis						•			•								•				
F. crotonensis																					•
F. lapponica		+	⊙	•	•																
F. leptostauron	•		•	•	⊙	⊙															
F. parasitica																				•	
F. pinnata	+	+	+	+	•	+			⊙	•				•			•	•	•		
F. Vaucheriae												•						•			•
Gomphonema acuminatum																•			•	•	
G. acuminatum v. coronata					•						•		•				•	•		•	•
G. acuminatum v. pusilla										•								•			

TABLE II—L-9 (continued)

	Depth in feet																				
	25	24	23	22	21	20	19	18	17	16	14	12	10	9	8	6	4	2	B	M	T
G. constrictum																				•	
G. constrictum v. capitata																				•	•
G. intricatum v. pumila												•		•			•	•	•	•	•
G. sphaerophorum																			•		
Gyrosigma attenuatum					•							•			•	•	•	•		•	
Mastogloia Smithii v. lacustris								⊙	•	•	•	⊙	•						•		
Melosira ambigua																	•	•		+	•
Meridion circulare					•	•														•	•
Navicula americana											•	•	•	•			•				
N. cuspidata																		•			
N. dicephala				•	•	•				•		•	•				•	•	•		
N. exigua																		•			
N. gastrum								•													
N. graciloides	•			•	⊙	•		•		•	•	⊙			•		•	•	•	•	•
N. oblonga										•							•	•			
N. peregrina					•					•		•			•	•					
N. protracta		•	+	+	⊙	⊙	•	⊙	⊙	•	•	⊙	•	•	⊙	•	⊙	⊙	⊙	•	
N. pupula v. rectangularis				•		•															
N. radiosa					•	•							•			•	•	•	•	•	•
N. radiosa v. tenella																					•
N. scutelloides				•	⊙	•		•			•	•	•							•	
N. tuscula					•					•	•	•						•		•	
Neidium iridis					•	•		•	•	•	•	•				•	•				
Nitzschia Denticula				•	•			•		•											
Odontidium hyemale					•																
Opephora Martyi				•	•	•	•	•	•	•	⊙	⊙	⊙	•	•	•	•	•		•	

TABLE II—L-9 (continued)

	Depth in feet																				
	25	24	23	22	21	20	19	18	17	16	14	12	10	9	8	6	4	2	B	M	T
Pinnularia bihastata																	•	•		•	
P. hemiptera															•						
P. maior								•													
P. mesolepta v. stauroneiformis				•																	
P. nobilis											•	•						•		•	
P. nodosa					•	•															
P. streptoraphe																	•				
P. viridis			•					•	•	•	•	•	•	•	•	•	•	•	•		
Rhopalodia gibba																				•	
Stauroneis acuta													•			•	•		•		
S. anceps												•								•	
S. phoenicenteron						•					•	•				•	•	•	•	•	•
Stephanodiscus astraea																				•	•
Surinella angusta																				•	•
S. biseriata																				•	
S. spiralis										•											
Synedra acus v. angustissima																					⊙
S. amphicephala																				•	
S. capitata																					•
S. ulna v. danica																				•	•
S. ulna v. longissima																				•	
S. ulna v. subaequalis																				•	•
Tabellaria fenestrata																			•	•	

B, M, T — refer to the bottom, middle, and top of a Naumann Tube Sample

TABLE III—L-1-A

Symbols: Rare— — Present— • Frequent— ⊙ Common or abundant— +

Periods (Deevey, emended)

A_1 | ← A_2 → | B | ← C_1 → | ← C_2 → |

Depth in feet

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	R*
Achnanthes exigua							•	•	•	•						
A. exigua v. heterovalvata			•		•											
Amphora ovalis v. affinis			•	•	•	•	•	⊙	•	⊙	•					
Caloneis trinodis							•									
C. silicula							•	•								
Cocconeis placentula						•	⊙	•	•						⊙	⊙
Cyclotella compta v. radiosa	•		+	+	⊙	•	•	•	•							
C. ocellata							•									
Cymbella affinis							•	•								
C. amphicephala									•							
C. aspera								⊙	•	•		•	•			•
C. cistula			•				⊙	⊙	⊙				•		⊙	•
C. cuspidata					•		•	⊙	•							
C. cymbiformis						•			•							
C. Ehrenbergii			•	•	⊙		⊙	⊙	•	•	•					
C. naviculiformis								•								
C. rupicola						•	•	⊙	•	•		•				
C. scotica								•								
C. similis		+	+	⊙	⊙											
C. turgida							•									
C. ventricosa			⊙	•		•	•	•	•	•						
Cystopleura turgida	•			•	•		•		•				•		•	
C. turgida v. granulata	•		•	•			⊙	⊙	•							⊙

TABLE III—L-1-A (continued)

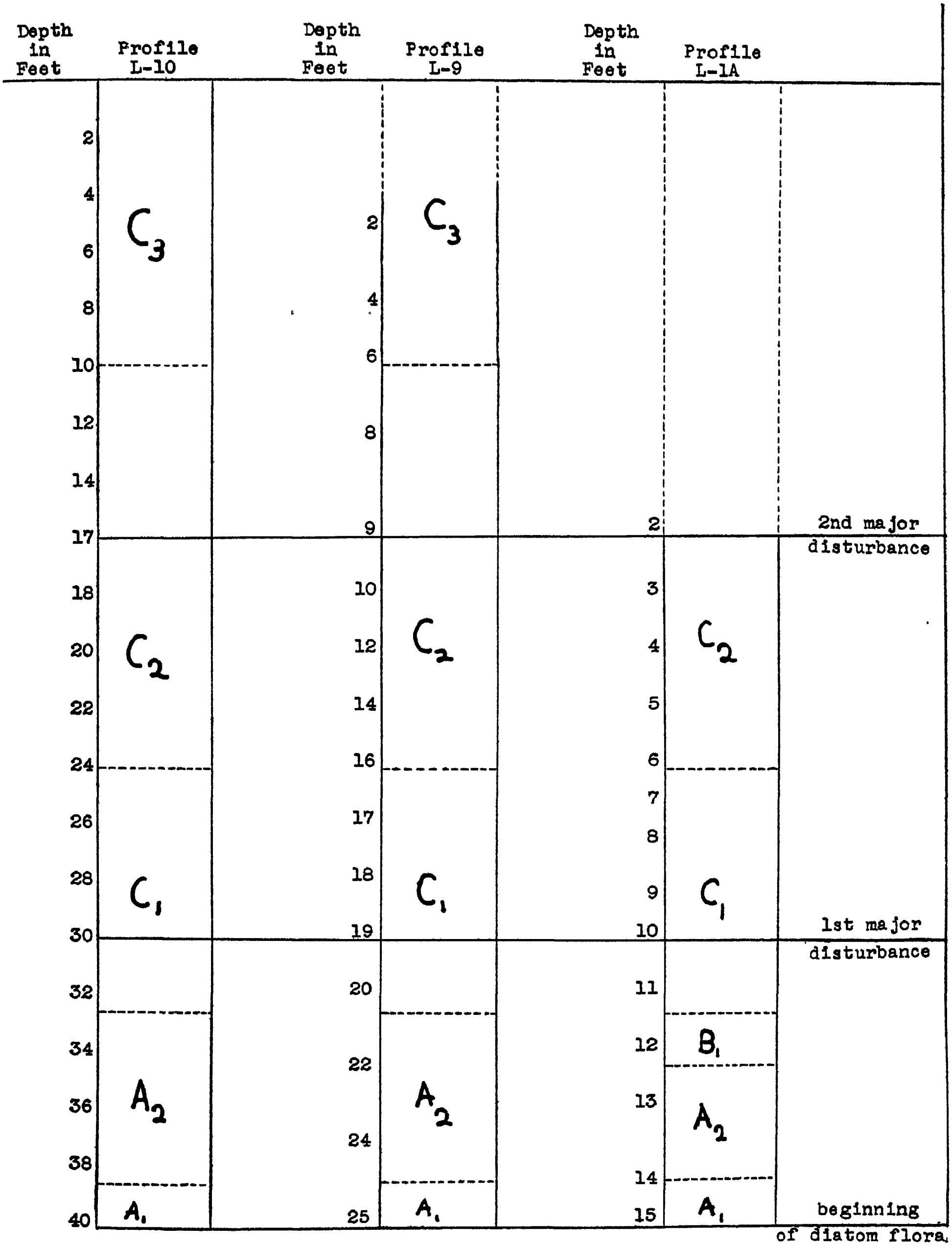
	Depth in feet														
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	R*
C. zebra v. porcellus	•					•	⊙									
C. zebra proboscidea									•							
C. zebra v. saxonica						•	•	•								⊙
Eucocconeis flexella			⊙	•	•	•	⊙	•	•							
Eunotia arcus					•	•	•	•				•				•
E. arcus v. fallax							•									
E. diodon			•	•	•	•	•	•	•	•						
E. formica			•		•	•				•	•		•		⊙	
E. lunaris													•			
E. monodon															•	
E. monodon v. maior															•	
E. pectinalis v. minor			⊙	•											⊙	
E. pectinalis v. minor f. impressa							•						•			•
E. praerupta					•			•								
E. veneris													•		•	
Fragilaria brevistriata	⊙	•	⊙	•	•	•	•	•	•	⊙						
F. construens	⊙	•	+	+	⊙	⊙	⊙	⊙	+	⊙	•				•	
F. construens v. binodis	•		⊙	•	•				•							
F. lapponica			•	•	•											
F. leptostauron	•		•	•												
F. pinnata	+	•	⊙	⊙		•	⊙	⊙								
F. Vaucheriae			•			•	•		•				⊙			•
F. virescens			•													
Gomphonema acuminatum v. coronata			•	•	•	•	⊙	•	•				•		•	
G. acuminatum v. pusilla					•	•	•	•								
G. augur								•					•			
G. constrictum							•	•	•							
G. constrictum v. capitata																•

TABLE III—L-1-A (continued)

	Depth in feet															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	R*
G. intricatum v. pumila							•	•								
G. subtila v. sagitta					•	•	•	•	•							
Gyrosigma attenuatum					•			•		•						
Mastogloia Grevillei					•	•	•	•								
M. Smithii v. lacustris			•	•	⊙	•	⊙	+	⊙	+		•				
Navicula bacillum							•									
N. dicephala						•	•	•	•	•						
N. gastrum								•								
N. graciloides			•				•	•	•	⊙			•			
N. oblonga							•	⊙	•	•						
N. protracta			•	•	+	⊙	⊙	⊙	⊙	+	•					
N. pupula v. rectangularis								•								
N. radiosa						•		•		•			•		•	•
N. scutelloides	•	•														
N. tuscula			•		•		⊙	⊙	⊙	•						
Neidium iridis					•		•	•	•	⊙	•	•				
Nitzschia Denticula	•		•	•		•	•	•	•	•						
Opephora Martyi			•	•		•	•	⊙	⊙	⊙	•	•				
Pinnularia maior							•	⊙	•	•						
P. viridis			•		•		⊙	⊙	•	•	•	•				•
Rhopalodia gibba															•	⊙
Stauroneis acuta								•								
S. phoenicenteron					•	•	•	⊙	•	•						
Synedra amphicephala							•	•		•			•			•
S. ulna v. subaequalis																•
Tabellaria fenestrata			•		•		•	•	•				•		•	

R — refers to present-day collections

TIME TABLE OF CHANGES OCCURRING IN LINSLEY POND AS BASED ON THE STUDY OF DIATOMS



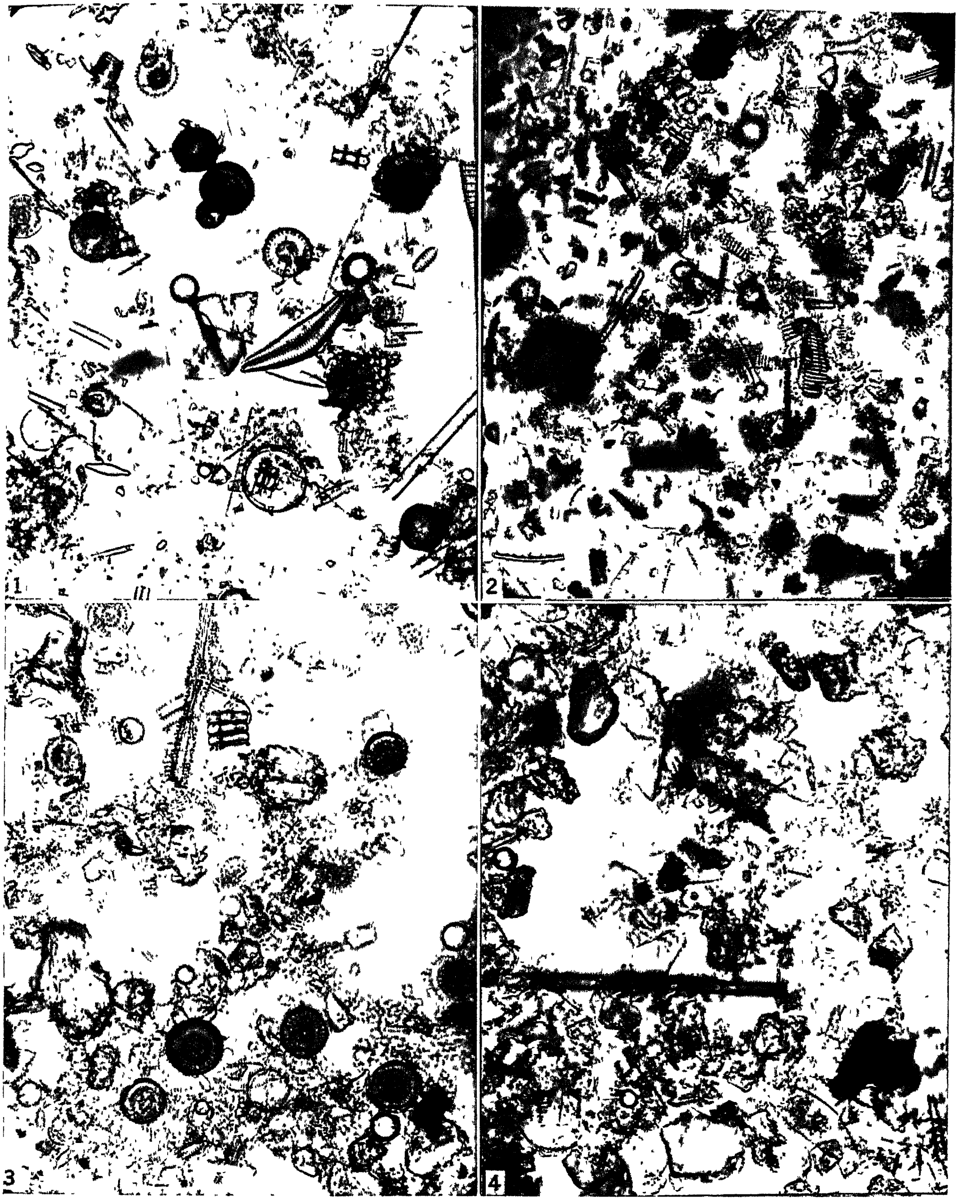
EXPLANATION OF PLATES 11 AND 12

PLATE 11.

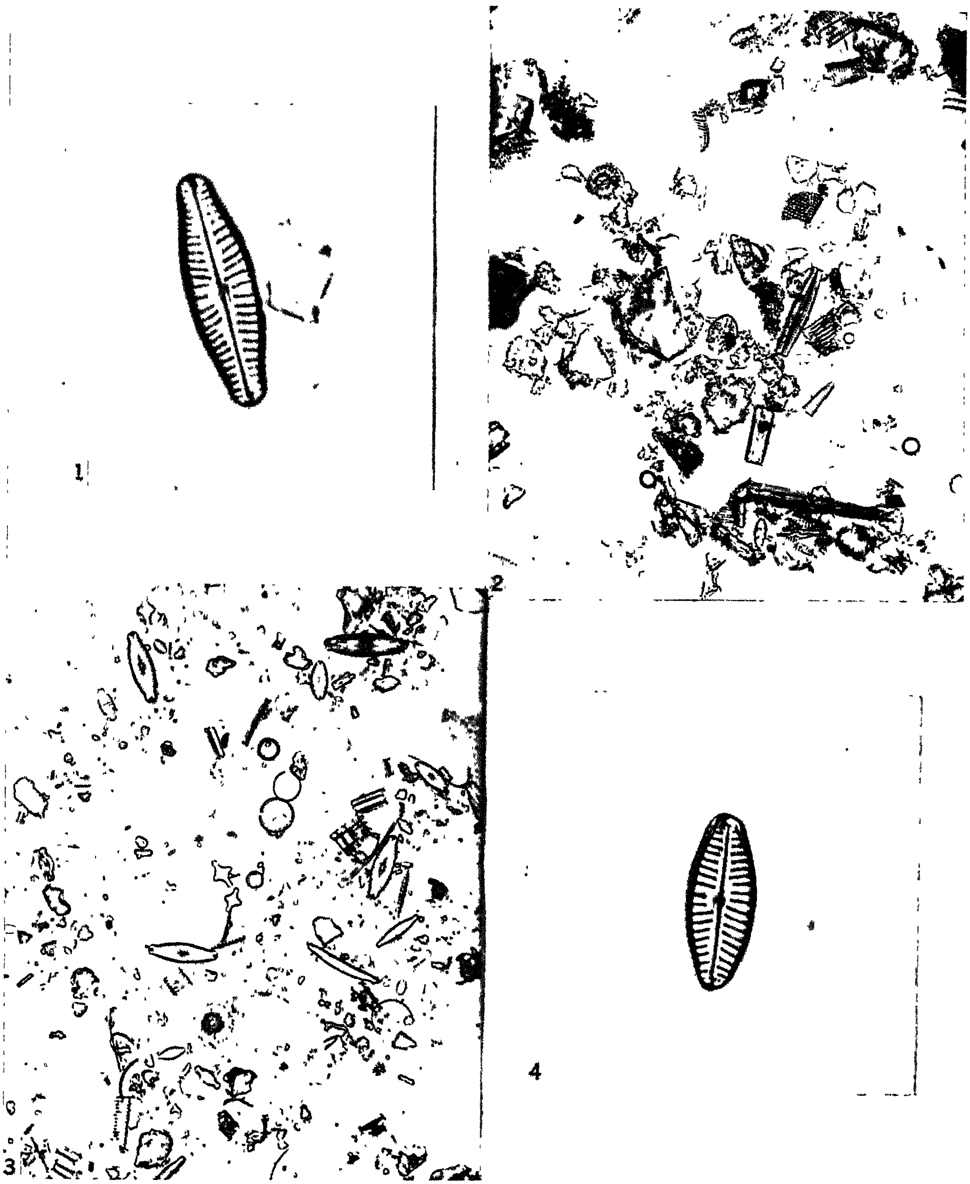
FIG. 1.—L-10, 32 ft. level. (× 375.)
FIG. 2.—L-10, 30 ft. level. (× 375.)
FIG. 3.—L-9, 20 ft. level. (× 375.)
FIG. 4.—L-9, 19 ft. level. (× 375.)

PLATE 12.

FIG. 1.—*Cymbella similis* new species. (× 1286.)
FIG. 2.—L-1A, 10 ft. level. (× 375.)
FIG. 3.—L-1A, 11 ft. level. (× 375.)
FIG. 4.—*Cymbella similis* new species. (× 1339.)



PATRICK: THE DIATOMS OF LINSLEY POND, CONNECTICUT



PATRICK: THE DIATOMS OF LINSLEY POND, CONNECTICUT

THE BIRD-LOCUSTS OF THE AFRICAN GENUS ORNITHACRIS (ORTHOPTERA; ACRIDIDAE; CYRTACANTHACRIDINAE)

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The bird-locusts of the genus *Ornithacris* include some of the most striking species of this interesting and important group, as the often vivid coloration of their wing-disks is surpassed in none and equalled in but few of the other members of the Group Cyrtacanthacres.

An opportunity to collect several species of these beautiful insects, while on the George Vanderbilt African Expedition of 1934, kindled my interest in them, and several years ago I had partially completed a revisionary study of the genus. On learning that my friend Dr. B. P. Uvarov, of the British Museum (Natural History), the original describer of the genus, was then engaged in a similar study, I laid aside my uncompleted work to await the publication of his contribution. When this appeared, early in 1942,[1] I made a critical comparison of my notes and comments with Dr. Uvarov's latest conclusions.

The results of this comparison were that while in many respects I agreed with Dr. Uvarov's conclusions, in others I differed materially, as to the importance of certain color features used by him as diagnostic, and also in the relative value of the various units into which the genus is divisible. In consequence I have completed my analysis of the elements comprising the genus, broadening its discussions to give full weight to Dr. Uvarov's later work, and the same is here presented as an additional contribution to the systematics of the African bird-locusts, and incidentally to African zoogeography. One form previously unrecognized is described, one which requires such action has been renamed, and the interpretation of a third, seriously muddled in past literature, has been clarified.

Unless it has been required to amplify or explain conclusions presented in the present paper, information which appeared in previous papers by Dr. Uvarov treating of this genus has not been repeated, and for much discussion of pertinent character the student is referred to these prior studies, to which citations are given under the various forms.

[1] "A Revision of the Genus Ornithacris Uvarov, 1924 (Orthoptera, Acrididae)." Ann. and Mag. Nat. Hist., (11) IX, pp. 135-140. February, 1942.

ORNITHACRIS Uvarov

1923. *Glaphyra* Uvarov, Ann. and Mag. Nat. Hist., (9) XI, p. 144. (Preoccupied by *Glaphyra* Newman, 1840.)

1924. *Ornithacris* Uvarov, Ann. and Mag. Nat. Hist., (9) XIII, p. 9. (Replacement name.)

1942. *Ornithacris* Uvarov, Ann. and Mag. Nat. Hist., (11) IX, p. 135. (Revision of genus.)

Genotype (by original indication of Uvarov, 1923).—*Gryllus* (*Locusta*) *cyaneus* Stoll.

In his study of 1923 and 1924 Uvarov has given an analysis of the generic characters which it is not necessary to repeat here. In the 1923 key to the genera of the bird-locusts, and in which the preoccupied name *Glaphyra* was proposed for this genus, the leading generic features were presented, and in 1924, when treating the genus as a whole, these were amplified to include other characters of value but less critically diagnostic. The completely coriaceous proximal half of the tegmina, with the veinlets of that area incrassate and confluent, together with the heavily impresso-cribrose character of the pronotal surface, the well indicated, usually pronounced and elevated, median carina of the pronotum, the strongly bent prosternal spine, and the red or violet wing-disks present the combination of features peculiar to *Ornithacris*. The sole other African genus of the group with distinctively colored wing-disks is *Gowdeya* Uvarov, and in that the head and pronotal structure is quite different, the wings are not at all hyaline distad, the medio-dorsal carina of the caudal femora is strongly serrate, and the prosternal process is not strongly bent caudad. In addition *Gowdeya* belongs to an entirely different section of the Group Cyrtacanthacres, and has its nearest relative in the Philippine genus *Melicodes*.

Relationship.—The systematic position given the genus by Uvarov is in my opinion correct. This is, flanked on one hand by the African and Malagasy genus *Nomadacris* Uvarov, and on the other by the exclusively African genus *Acanthacris* of the same author. From both of these, however, *Ornithacris* is very distinct, and none of the forms included in it is to any degree truly transitional to either of the related genera. The sequence of species which is presented in this paper is, in my opinion, one which gives the nearest approach in minor tendencies toward the two linearly associated genera. As has already been noted by Uvarov,[2] there is a superficial resemblance in *O. turbida cavroisi* to the Oriental genus *Patanga*, and especially to the species *P. succincta*, but this is not at all indicative of an intimate relationship.

Distribution.—The genus is broadly distributed over Africa south of the Sahara, except for its virtual absence from both districts of the Guinean Forest Province. It ranges northward to Senegal and the Kordofan district of the Anglo-Egyptian Sudan, and southward to the southern coast of Cape

[2] Ann. and Mag. Nat. Hist., (9) XIII, p. 13, (1924).

Province, while from Senegal, Gambia and Portuguese Guinea, as well as the lower Congo, Angola and Southwest Africa, it extends eastward to Ethiopia, Kenya, Portuguese East Africa and Natal. We have little evidence of its presence within the typical lowland forest, and where it may occur I feel it is but marginally intrusive. Arid conditions as found in the Windhoek, Southwest Africa, neighborhood, and at localities in the Kalahari, do not prevent the occurrence of the genus, and probably one or more forms will be found in almost any section of the area broadly given above as that of the generic distribution.

Summary of Previous and Present Taxonomic Conclusions.—Uvarov in 1924[3] considered that the genus included five forms, which in his opinion were of no higher rank than subspecies of *cyanea*, the name given by Stoll to the first known member of the genus. At that time, and as recently as 1942,[4] the former author considered that the presence or absence of paired humeral pale bars on the pronotum was a feature of systematic importance. Similarly in his earlier paper Uvarov was of the opinion that there was but one form with violaceous wing-disks, and also that Sjöstedt's variety *orientalis* was based upon this form, for which the much older name *cyanea* Stoll was used.

In 1929 Miller[5] showed that Stoll's original material of *cyanea*, now in the Leiden Museum, possesses paired humeral pale bars on the pronotum, and in consequence he regarded it as distinct from Uvarov's *cyanea* of 1924, all of whose specimens lacked such pale bars. For the form without the pale humeral bars Miller used Sjöstedt's name *orientalis*, considering it to represent a sixth subspecies. In his 1942 study Uvarov[6] followed Miller regarding the occurrence of two violaceous-winged forms, and used the same names for them, but the degree of elevation of the pronotal median keel was regarded as the differential criterion. However, Uvarov at that writing still regarded the presence or absence of pale humeral pronotal bars as of diagnostic importance in connection with other forms of the genus. In Uvarov's later work (1942) the number of forms is raised to seven, a new one, named *rosea*, being described.

Briefly my present conclusions differ from those in Uvarov's last study in that I consider the genus contains eight forms, but that these, instead of being merely subspecies of a single species, represent four distinct species, one of which does not break into subspecies, while two divide into two subspecific units each, and another into three. It is also clearly evident that the presence or absence of paired humeral pale pronotal bars is of no systematic importance, material of individual forms now before me from the

[3] Ann. and Mag. Nat. Hist., (9) XIII, pp. 9-14, (1924).
[4] Ann. and Mag. Nat. Hist., (11) IX, pp. 135-140, (1942).
[5] Trans. Entom. Soc. London, 1929, p. 84, (1929).
[6] Ann. and Mag. Nat Hist., (11) IX, pp. 136-139, (1942).

same locality having them present or absent. It is also clear that Sjöstedt's name *orientalis* is not based on a violaceous-winged form, but instead on one with a wine red disk, in fact that to which Uvarov recently applied the new name *rosea.*

Evidence on Color Dimorphism.—Solely from the material now before me the evidence for dichromatism in this genus, in a way comparable to that now known to occur in the bird-locust genera *Schistocerca*[7] and *Valanga*,[8] is unquestionable. This dichromatism is one of pattern, and is restricted to the presence or absence of paired lateral pale pronotal bars. In *O. orientalis* as here understood and in *O. pictula pictula* pale bars are usually or always present as far as the material before me evidences, and conversely all the material of *O. pictula cruenta* I have seen lacks pale bars. In *O. turbida turbida* the series from Faradje, Belgian Congo, has the bars present or absent, and the same is true of that of *O. cyanea imperialis* from both Faradje and Niangara, Belgian Congo. From Palavange, Angola *O. pictula magnifica* has these bars present and in spite of dessication changes in material very probably absent as well, certainly absent in material from not distant localities. The evidence in this connection is discussed in more detail under the respective forms.

Evidence on Specific Distinctness of Certain Entities. — The usual criteria for the recognition of geographic subspecies are: first, the limitation of the respective subspecies to definite areas in which they maintain a relative uniformity of character, and there replace other subspecies of the same species which are similarly limited to distinctive but different areas, in which they occur to the exclusion of the others; and second, the integradation of these forms in the more or less restricted sections where the ranges of the subspecies meet.

Intergradation can frequently be demonstrated, if material is available from the often much restricted areas of such intergradation and confirmatory evidence thus apparent; in other cases it is assumed from the character instability of representatives from points toward the periphery of the range of any one of the subspecies, although the majority of specimens from that point may remain typical of their endemic form.

In the case of the various units making up the genus *Ornithacris*, it is clearly evident from the series now before me that to consider them as subspecies of a single form would be to ignore the evidence there presented. In certain relatively limited areas of Africa, such as that within a reasonable radius of Nairobi, Kenya, as many as three forms can conceivably occur, and two are definitely known from Nairobi alone (*cyanea imperialis*

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[7] See Rehn, Entom. News, XIII, p. 89, (1902); Rehn, Entom. News, XIII, p. 312, (1902); Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1907, pp. 292-293, (1907); Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1916, pp. 196-199, (1916).

[8] See Rehn and Rehn, Proc. Acad. Nat. Sci. Phila., XCII, pp. 259-260, (1941).

and *pictula cruenta*, the latter record from Uvarov). In the series now before me the following localities are represented by fully typical material of two distinct forms: Zululand (*orientalis* and *pictula pictula*); Pretoria, Transvaal (*orientalis* and *pictula pictula*); Zimbabwe, Southern Rhodesia (*orientalis* and *pictula cruenta*); Abercorn, Northern Rhodesia (*orientalis* and *pictula cruenta*); Niangara, Belgian Congo (*cyanea imperialis* and *turbida turbida*), and Faradje, Belgian Congo (*cyanea imperialis* and *turbida turbida*). It is clearly evident from this that the forms recognizable in this genus are not all subspecies of a single species, as most of the forms listed above as occurring at the same localities are not blending types but instead strongly and distinctively different entities, as *cyanea imperialis* and *turbida turbida*, or *orientalis* and *pictula cruenta*. Typical material of these forms differs so markedly that with this evidence of their occurrence at the same place, there can be no course open but to consider them distinct specific entities.

Systematic Arrangement of Forms.—My conclusions are that we have four specific units in the genus *Ornithacris*, and I would arrange them with their various subspecies in the following sequence, starting with types approximately nearest to *Nomadacris*, which linearly precedes the present genus.

Ornithacris turbida turbida (Walker)
Ornithacris turbida cavroisi (Finot)
Ornithacris cyanea cyanea (Stoll)
Ornithacris cyanea imperialis new subspecies
Ornithacris orientalis (Sjöstedt)
Ornithacris pictula pictula (Walker)
Ornithacris pictula magnifica (I. Bolívar)
Ornithacris pictula cruenta new subspecies

The forms placed under *turbida* have quite low-crested pronota, with relatively narrow tegmina and the wing-disk pale or weak red, sometimes the remainder of the wings infuscate. They are limited to the Sudanese and Guinean Savanna Provinces.[9]

Those considered races of *cyanea* have a pronotal crest of medium height, this strumosely thickened, the tegmina broader but yet not of the broadest type, and the wing-disk definitely a shade of violet purple. They are peculiar to the Guinean Savanna Province and parts of the Northeast African Province and of the East African Highland District.

The species *orientalis* has a pronotal crest of medium height, proportionately narrow tegmina, and a wing-disk of rose or even wine-red. It extends over much of the Eastern and Southern Province north to Kenya.

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[9] For the mapping of these areas see Chapin's map of the faunal areas of the Ethiopian Region. Bull. Amer. Mus. Nat. Hist., LXV, p. 90, (1932).

Under *pictula* we have forms which vary among themselves very greatly in size, including the extremes in bulk known in the genus, but they agree in having a more compressed and deeper pronotum, a relatively high and well arcuate pronotal crest, quite broad tegmina with a usually distinctive color pattern, and wing-disks ranging from scarlet to carmine. They are natives of the Eastern and Southern Province, but also extend into the Southern Congo Savanna District.

Key to the Forms of Ornithacris

1. Wings with disk violet or purple, never red or reddish...............2
   Wings with disk light red to scarlet, never violet or purple...........3
2. Pronotal crest, as viewed in profile, low, little arcuate; caudal angle of pronotal disk less sharply angulate...........*cyanea cyanea* (Stoll)
   Pronotal crest, as viewed in profile, higher, definitely arcuate; caudal angle of pronotal disk more sharply angulate.
   cyanea imperialis new subspecies
3. Pronotal crest scarcely or but moderately elevated. Tegmina proportionately more elongate and slender..............................4
   Pronotal crest strongly elevated, definitely convex in profile outline. Tegmina proportionately less elongate and broader................6
4. Wing-disk pale red, never bright rose color. Form as a whole more elongate, tegmina and wings more attenuate......................5
   Wing-disk bright rose color. Form as a whole more robust, less elongate, tegmina and wings less attenuate...............*orientalis* (Sjöstedt)
5. Pronotal crest more arcuate as seen in profile (particularly in females), median carina of same as seen from dorsum occupying virtually the entire width of the pale medio-dorsal pronotal marking on the prozona, on the metazona the carina narrows progressively caudad, the pale area largely polished and but slightly cribroso-areolate on prozona, areolate laterad on metazona; caudal angle of pronotal disk with apex more sharply angulate and but little rounded. Tegmina with elements of oblique pale pattern of proximal three-fifths narrower. Wings with peripheral margin of axillary field less strongly arcuate; wing-disk nearer rust red,[10] more distal section appreciably infuscate in typical material........................*turbida turbida* (Walker)
   Pronotal crest less arcuate as seen in profile (particularly in females), median carina of same finely marked, narrowly glabrous, remainder of area of pale medio-dorsal pronotal marking nearly or quite as cribrosely impresso-areolate as remainder of pronotal dorsum; caudal angle of pronotal disk more definitely rounded at immediate apex. Tegmina with elements of oblique pale pattern of proximal three-fifths broader (at least in female). Wings with peripheral margin of axillary field more strongly arcuate; wing-disk pale pinkish red, more distal section hardly at all infumate.........*turbida cavroisi* (Finot)

[10] Near "dragon's-blood red" of Ridgway.

6. Size (for genus) small. Form less attenuate, pronotal compression less decided. Wing-disk light coral red to coral red. Male subgenital plate less produced. (Tegmina with obliquely transverse pale pattern markedly and strongly anastomosing in distal half.)
pictula pictula (Walker)

Size large. Form more attenuate, pronotal compression more pronounced. Wing-disk full scarlet to pale carmine. Male subgenital plate more produced. 7

7. Tegmina proportionately narrower, pale pattern of distal less coriaceous half usually more evident and made up of a number of obliquely disposed undulate bars or groups of areolae. Wing-disk scarlet (of Ridgway).[11] Pronotum of female less strongly compressed; median carina of same evenly arcuate in profile. *pictula magnifica* (I. Bolívar)

Tegmina proportionately broader, pale pattern of distal less coriaceous half much less evident, made up of scattered areolae or not more than a single incomplete bar. Wing-disk pale carmine. Pronotum of female more strongly compressed, proportionately narrower cephalad; median carina of same not as evenly arcuate in profile.
pictula cruenta new subspecies

In the course of the present study I have examined 92 specimens, derived originally from the following sources: 35 in the collection of the Academy of Natural Sciences of Philadelphia and the Hebard Collection there deposited; 32 from that of the American Museum of Natural History; 4 from the collection of the Transvaal Museum; 13 from that of the University of Pretoria; 4 from the Berlin Zoological Museum; 2 from the Museum of Comparative Zoology, and one each from the United States National Museum and the Hamburg Museum. I wish to thank the officials in charge of these collections for the opportunity to study their series.

Ornithacris turbida turbida (Walker) Fig. 7; pl. 13, fig. 11; pl. 18, figs. 27-28.

1870. *Cyrtacanthacris turbida* Walker, Catal. Derm. Salt. Brit. Mus., III, p. 556. [♀; Congo.]

1870. *Cyrtacanthacris inclyta* Walker, Catal. Derm. Salt. Brit. Mus., III, p. 558. [♀; Fantee [Gold Coast].]

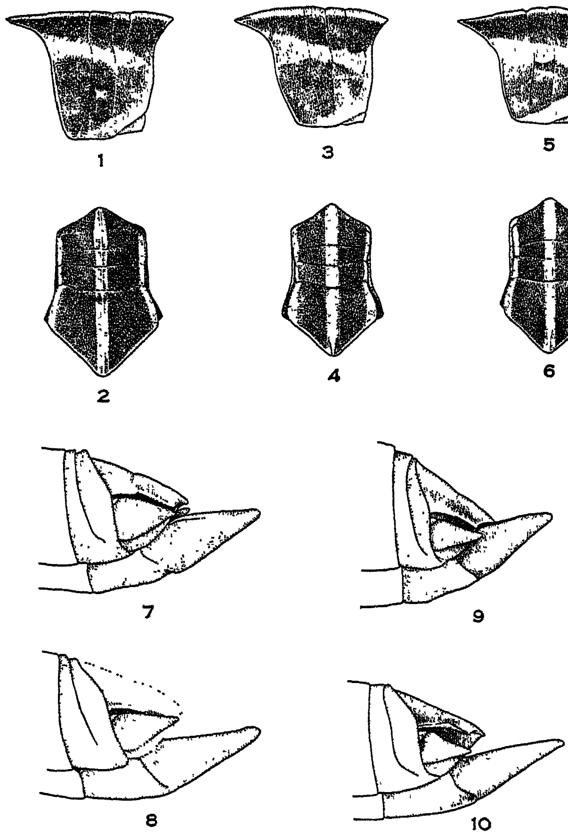
1924. *Ornithacris cyanea turbida* Uvarov, Ann. and Mag. Nat. Hist., (9) XIII, p. 13. (Synonymy established.)

1942. *O[rnithacris] cyanea turbida* Uvarov, Ann. and Mag. Nat. Hist., (11) IX, pp. 136, 140.

My concept of *O. t. turbida* has been drawn from material determined by Uvarov as that form, after comparison with Walker's type material in the British Museum of Natural History. The synonymy of *C. inclyta* under *turbida* is taken from Uvarov, as the Walkerian descriptions of both *turbida* and *inclyta* are far too general for one to reach any warranted conclusions without that author's types being before them.

The material before me shows conclusively that *turbida* and *cavroisi*, which occupy contiguous areas, definitely intergrade, and while the east and

[11] This is equal to "cinnabar" of authors.



Ornithacris cyanea cyanea (Stoll). Female. Russisi River, southwest Urundi, Belgian Congo. Figs. 1 and 2.—Lateral and dorsal views of pronotum. (× 1½.)

Ornithacris cyanea imperialis new subspecies. Male (type). Ekibondo, Uele District, Belgian Congo. Figs. 3 and 4.—Lateral and dorsal views of pronotum. (× 1½.)

Ornithacris orientalis (Sjöstedt). Male. Chai Chai, Portuguese East Africa. Figs. 5 and 6.—Lateral and dorsal views of pronotum. (× 1½.)

Ornithacris turbida turbida (Walker). Male. Yapi, Gold Coast. Fig. 7.—Lateral view of apex of abdomen. (Greatly enlarged.)

Ornithacris turbida cavroisi (Finot). Male. Kirrippi, Anglo-Egyptian Sudan. Fig. 8.—Lateral view of apex of abdomen. (Greatly enlarged.)

Ornithacris pictula pictula (Walker). Male. Between Knysna and George, Cape Province. Fig. 9.—Lateral view of apex of abdomen. (Greatly enlarged.)

Ornithacris pictula magnifica (I. Bolívar). Male. Kimuenza, Lower Congo District, Belgian Congo. Fig. 10.—Lateral view of apex of abdomen. (Greatly enlarged.)

west distribution of each is considerable, their respective north and south extents are much more limited. True *turbida* appears to be typically a form of the northern districts of the Guinean Savanna Province, while *t. cavroisi* is more truly one of the Sudanese Province.

The key to the forms of the genus emphasizes the features that distinguish these two forms, which typically look quite different. The character of the development of the pronotal median carina serves to separate material of the two forms quite readily, but atypical individuals of *t. turbida,* while typical in that respect, show the beginning of passage toward *T. cavroisi* in the straighter profile of the pronotal dorsum, the less sharply angulate caudal margin of the pronotal disk, the paler wing-disk and the much weaker infuscation of the non-discal portion of the wing. In addition, the more lateral cribrose punctations of the pronotal disk surface encroach upon the prozonal portion of the glabrous median paler area, in these atypical specimens, to a greater degree than in the typical individuals.

The lesser fullness of the arcuation of the peripheral margin of the axillary field of the wing of *t. turbida,* when compared with that of *t. cavroisi,* is quite evident. Atypical individuals of *t. turbida* usually show a stronger arcuation of this margin, indicating the *O. t. cavroisi* influence.

Measurements (in millimeters) of representative specimens of *t. turbida* are as follows:

	Length of body	Length of pronotum	Length of tegmen	Length of caudal femur
Typical				
♂, Yapi, Gold Coast	58	12.5	54.5	29
♀, Yapi, Gold Coast	66.5	12	67	39
♀, Njana Farm, Belgian Congo..	74.5	16.8	68+	42
♀, Kasenyi, Belgian Congo	72	16.8	66+	41
Atypical				
♂, Faradje, Belgian Congo	62	13	55.5	31
♀, Niangara, Belgian Congo	73	16	75	43
♀, Faradje, Belgian Congo	68	15	69	38
♀, Anglo-Egyptian Sudan	80	16.9	76	42

All of the male specimens before me have virtually no trace of paired postocular pale humeral bars on the pronotum, and the same is true of all the females from Niangara, Njana Farm and Kasenyi, Belgian Congo, and that from the Anglo-Egyptian Sudan, while of the four females from Faradje, Belgian Congo, two have virtually no trace of such bars, one has them weakly indicated and another, like the Yapi female, has them pronounced. The Garamba female has been dried from alcohol and is discolored, but apparently it had the bars well indicated. It is clearly evident that presence or absence of these bars has no taxonomic significance in the *turbida* assemblage.

The distribution of *O. t. turbida* is now known to extend from the Gold Coast (Fantee, Yapi,[12] Sarkwalla and Buave) and Southern Nigeria eastward to certain areas in the northeastern Belgian Congo (Aru, Faradje,[13] Njana Farm, Kasenyi [14] and Mahagi Port, the two latter on Lake Albert), Uganda (Butiaba, Kalesizo and Lango) and southern Anglo-Egyptian Sudan (Liria). The southern boundary of its distribution may be found an appreciable distance south of these points, but I question whether this form ever enters the true forest province. It is probably a savanna-land form, replaced northward in the Sudanese Province by *t. cavroisi*, with which, as stated above, it intergrades. Material from Niangara, Faradje and Garamba, in the northeastern Belgian Congo, is clearly atypical in the features already discussed, and thus shows definitely passage toward *O. t. cavroisi*.

Specimens examined: 12; 3 ♂, 9 ♀.

Typical *O. t. turbida*

GOLD COAST: Yapi, Northern Territories; VII, 1914 (♂), 1916 (♀); (Jas. J. Simpson); 1 ♂, 1 ♀; [Hebard Cln.].[15]

BELGIAN CONGO: Njana Farm, near Tinda Bridge, Region of Bunia, Kibale-Ituri District, elevation 3500 feet; VIII, 29, 1934; (George Vanderbilt African Exped.; J. A. G. Rehn); 1 ♀; [A.N.S.P.]. Kasenyi, Lake Albert, Kibale-Ituri District, elevation 2100 feet; VIII, 27, 1934; (George Vanderbilt African Exped.; J. A. G. Rehn); 1 ♀; [A.N.S.P.].

Atypical *O. t. turbida*

BELGIAN CONGO: Niangara, Uele District; XI, 20-25, 1910; (Lang and Chapin); 1 ♀; [A.M.N.H.]. Faradje, Uele District; 1911, XII, 19, 1912—I, 15, 1913; (Lang and Chapin); 2 ♂, 3 ♀; [A. M. N. H. and A. N. S. P.]. Garamba, Uele District; III, 19, 1912; (Lang and Chapin); 1 ♀; [A. M. N. H.].

ANGLO-EGYPTIAN SUDAN: No exact locality; 1 ♀; [A.N.S.P.].

Ornithacris turbida cavroisi (Finot) Fig. 8; pl. 13, fig. 12; pl. 18, figs. 29-30.

1907. *Acridium cavroisi* Finot, Ann. Soc. Entom. France, LXIV, p. 272. [♀; Diaoudaoun, near St. Louis, Senegal.]

1908 *Acrydium cyaneum* var. *tereticolle* I. Bolívar, Mém. Soc. Entom. Belg., XVI, p. 110. [♀; Calikis, Portuguese Guinea.]

1924. *Ornithacris cyanea cavroisi* Uvarov, Ann. and Mag. Nat. Hist., (9) XIII, p. 13, fig. 9 E. (Synonymy established.)

1942. *O[rnithacris] cyanea cavroisi* Uvarov, Ann. and Mag. Nat. Hist., (11) IX, pp. 136, 140.

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[12] This is erroneously given as "Tapi" by Uvarov in both of his studies.

[13] Given in error as "Foradje, Haut Huri" by Uvarov in 1942.

[14] In error by Uvarov in 1942 as "Kasengvi."

[15] Determined by Uvarov as *O. cyanea turbida* (Walker).

The above synonymy, established by Uvarov in 1924, appears to be correct, and I have before me a female specimen determined as *cavroisi* by that author.

Comments made above under *O. t. turbida* make clear the relationship of these subspecies, which definitely intergrade.

The three specimens of *O. t. cavroisi* before me all possess paired post-ocular pale humeral bars on the pronotum, and their measurements (in millimeters) are as follows:

	Length of body	Length of pronotum	Length of tegmen	Length of caudal femur
♂, Kirrippi, Anglo-Egyptian Sudan	56.5	12	56	30
♀, Bibianaha, Gold Coast	72	16.5	69	41
♀, Anglo-Egyptian Sudan	67.5	14.7	67	38

The distribution of this form is now known to extend from the Cape Verde Islands (St. Vincent) and Senegal (Dakar and Diaoudaoun, near St. Louis) westward across parts of the Gold Coast, the Middle Niger region of the French Sudan, Northern Nigeria and Lake Chad to the Anglo-Egyptian Sudan (Libyan Desert in northwest Kordofan; Um-Darag, Kordofan; Bor on the Upper Nile, and Kirrippi, which is close to the Uganda boundary) and eastern Uganda (Karamoja between Moroto and Kadawe). It is clearly a Sudanese Province form, intergrading southward into the Guinean Savanna Province form *t. turbida*.

Specimens examined: 3 ♂ ; 1 ♂, 2 ♀.

Gold Coast: Bibianaha; IX–XII, 1909; (Dr. Spurrell); 1 ♀ ; [Hebard Cln.].[16]

Anglo-Egyptian Sudan: Kirrippi, Bahr-el-Jebel District; XI, 12, 1921; (C. H. Lankester); 1 ♂ ; [A.N.S.P.]. No exact locality; 1 ♀ ; [A.N.S.P.].

Ornithacris cyanea cyanea (Stoll) Figs. 1-2; pl. 14, fig. 13.

1813. [*Gryllus* (*Locusta*)] *cyaneus* Stoll, Natuurl. Afbeeld. Beschr. Spoken, etc., p. 31, pl. XVb, fig. 56, register p. 13. ["Surinam" (in error).]

1924. *Ornithacris cyanea cyanea* Uvarov, Ann. and Mag. Nat. Hist., (9) XIII, p. 10.

1929. *Ornithacris cyanea cyanea* Miller, Trans. Entom. Soc. London, 1929, p. 84, pl. V, fig. 3, pl. IX, fig. 38. (Notes on and figures of Stoll's type.)

1942. *O[rnithacris] cyanea cyanea* Uvarov, Ann. and Mag. Nat. Hist., (11) IX, pp. 126, 138.

As frequently happened in the early years of systematic zoology, Stoll erroneously gave the habitat of this striking form as Surinam. Little attention was paid to the name subsequently until I. Bolívar in 1889[17] used it for violet-winged material of this subsequently described genus from Angola, while in 1908 he reported as *cyanea* similar specimens from a number

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[16] Determined by Uvarov.

[17] Jorn. Sci. Math. Phys. e Nat., Lisboa, (2) I, p. 159.

of localities in the Lower Congo District of the Belgian Congo.[18] In 1922 he also applied this specific name to individuals from Bourka and Harar in Ethiopia.[19]

Uvarov, in his classic revision of the Old World Cyrtacanthacrini, assumed that all violaceous-winged *Ornithacris* represented the same form, and stated,[20] " I do not hesitate to restrict the name " (i.e. *cyanea*) " to the race inhabiting the zone of mixed forests and grassland of Uganda and the Northern Congo, and extending also to Abyssinia." He also synonymized under typical *cyanea* Sjöstedt's *Acridium magnificum* var. *orientalis*,[21] from Kilimanjaro, which as I am showing on another page is a quite distinct form. In 1929 Miller,[22] after examining a photograph of the type of *cyanea* in the Leyden Museum, reached the conclusion that *cyanea* as understood by Uvarov in 1924, and as figured by I. Bolívar in 1922, differed from the Stoll type, of which latter he supplied a profile drawing of the pronotum.[23] However, Miller erred in considering the features separating *cyanea* of Stoll and *orientalis* of Sjöstedt, which latter named he used for the second violaceous-winged form, to be the presence in the former and the absence in the latter of pale lateral pronotal bars. As shown in the introductory note to the present study the presence or absence of these pale bars is of no systematic importance.

Uvarov in his quite recent revision of the genus [24] has modified his previous position by following Miller, thus recognizing two violaceous-winged forms, separated by a different degree of emphasis of the median pronotal carina, a feature I am discussing below, but which he believed placed *orientalis*, interpreted as violet-winged by him, close to I. Bolívar's *magnifica*. In reaching these conclusions Uvarov apparently disregarded Sjöstedt's comments on wing disk coloration in the description of *orientalis*.

In 1813 when Stoll figured and named *cyanea* the territory considered by Uvarov in 1922 to be the habitat of *cyanea* was an unknown land, except for the exceedingly limited exploration of Ethiopia which had been attempted. That material of an insect limited to that region could have reached Europe by 1813 is exceedingly improbable. On the other hand access to the immediate West African coast had been maintained with fair regularity for many decades preceding that time by slavers and trading

[18] Mém. Soc. Entom. Belg., XVI, p. 109.

[19] In Voy. du Baron Maurice de Rothschild en Ethiopie, etc., Résultats Scient., Anim. Artic., pt. 1, p. 187, Atlas pl. Io^2, fig. 3.

[20] Ann. and Mag. Nat. Hist., (9) XIII, p. 12, (1924).

[21] Wiss. Ergebn. Schwed. Zool. Exp. Kilimandj. Meru, 17, Orth., 7, pp. 183, 186, (1909).

[22] Trans. Entom. Soc. London, 1929. p. 84.

[23] Idem, pl. IX, fig. 38, (1929).

[24] Ann and Mag. Nat. Hist.. (11) IX. p 138, (1942).

ships. Everything in the way of historical probability would point to the coast of West Africa as the source of Stoll's material, and definitely confirmatory evidence is supplied by Miller's illustration of the pronotum of the type, which in its distinctive form is absolutely matched by a female before me from Boma, Lower Congo, a West Coast tidewater locality. This form undoubtedly is the same as that reported by I. Bolívar as *cyanea* in 1889 from Angola, and in 1908 from Mayumbe and Lower Congo localities near Boma.

As shown under *O. c. imperialis*, typical *O. c. cyanea* can be distinguished from the former, the only other form of the genus known with purple wings, by the lower, less arcuate dorsal pronotal outline as seen in profile, the slightly less acute angulation of the caudal margin of the pronotal disk, and the more pansy violet and less aster purple shade of the wing disk. In addition in *O. c. cyanea* there seems to be a somewhat more complex and extensive development of the pale elements of the tegminal pattern, particularly distad.

As here limited *O. c. cyanea* doubtless extends across the entire Belgian Congo south of the great forest area, as material now before me shows it also occurs in the relatively low Russisi Valley between Lakes Kivu and Tanganyika, on the boundary between the Belgian Congo, properly speaking, and Ruanda-Urundi. Uvarov [25] has recently reported it from N'Gwese, Lake Kivu, Belgian Congo, which is on the upper western slopes of the Russisi Valley; from "Lubale to Lwentobo," [26] Ankole Province, Uganda; Kalula, Mkalama, Old Shinyanga, Matalele, Singida and Itimbya, 30 kilometers north of Kahama, Tanganyika Territory. These localities show that the eastern known limit of the distribution of *O. c. cyanea* would be marked by Singida and Mkalama, Tanganyika Territory, and that it apparently does not cross the north and south disposed, more elevated, plateau-like central area of that region. It is probably a savanna-land form, or at least is one of the savannas south and east of the Lower Guinea Forest District.

Specimens examined: 3 ♀.

Belgian Congo: Boma, Lower Congo; I, 11, 1915; (Lang and Chapin); 1 ♀; [A.M.N.H.]. Russisi Plain, southwest Urundi, elev. 900 meters; IX, 15, 1911; (H. Meyer); 2 ♀; [A.N.S.P. and Berlin Zool. Mus.].

Ornithacris cyanea imperialis new subspecies Figs. 3-4; pl. 14, fig. 14.

1924. *Ornithacris cyanea cyanea* Uvarov, Ann. and Mag. Nat. Hist., (9) XIII, p. 10, fig. 9 D. (In part.)

1929. *Ornithacris cyanea orientalis* Miller, Trans. Entom. Soc. London, 1929, p. 84. (Not *Acridium magnificum* var. *orientalis* Sjöstedt.) (Probably in part only.)

1942. *O[rnithacris] cyanea orientalis* Uvarov, Ann. and Mag. Nat. Hist., (11) IX, p. 138. (Not *Acridium magnificum* var. *orientalis* Sjöstedt.)

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[25] Ann. and Mag. Nat. Hist., (11) IX, p. 139, (1942).

[26] I feel these names are transcriptional errors for Kabale to Lutobo, the former a well-known place in Ankole, and the latter a nearby village.

As shown on another page, I interpret Sjöstedt's *orientalis* as a form with a red and not a purple wing-disk, and the evidence for this conclusion, there presented, need not be repeated here.

This beautiful form is very close to true *cyanea* and doubtless, when sufficiently comprehensive series from a much greater number of localities are available, will be found to intergrade with that subspecies. At present I am considering them as subspecies of a single species on the basis of the degree of difference.

From *O. c. cyanea* the present form readily can be distinguished by the higher, more cristate and in profile more arcuate median carina of the pronotum,[27] the nearly or quite rectangulate caudal margin of the pronotal disk, and by the color of the wing-disk being nearer aster purple (of Ridgway) than it is to pansy violet. In addition the distal portion of the tegmina usually has a less extensive and less complex development of the pale elements of the pattern.

Type.—♂; Ekibondo, between Niangara and Dungu, Uele District, Belgian Congo. Elevation 2650 feet. September 30, 1934. (George Vanderbilt African Expedition of 1934; J. A. G. Rehn.) [Academy of Natural Sciences of Philadelphia, Type no. 5680.]

The features here stressed are essentially those of difference from *O. c. cyanea.*

Size medium (for genus); form as a whole somewhat more robust than in *c. cyanea;* surface sculpture largely as in same.

Pronotum quite definitely compressed, in profile the median carina is distinctly more cristate and the dorsal outline as a whole definitely arcuate longitudinally, the carina itself more thickened than in the typical form and its surface texture differs from that of the dorsum of the pronotum to the same degree as in *O. c. cyanea;* caudal margin of pronotal disk virtually rectangulate in the degree of production.

Tegmina, wings, prosternal spine and limbs as in *O. c. cyanea.*

Allotype.—♀; Niangara, Uele District, Belgian Congo. November 26–December, 1910. (Congo Expedition; Herbert Lang and James P. Chapin.) [American Museum of Natural History.]

Differing from the female sex of *O. c. cyanea* in the same respects as does the male sex of the present subspecies from that of the typical form of the species.

Coloration.—Pattern and tones as in *O. c. cyanea* except as follows: disk of wings more reddish purple than bluish purple, nearer aster purple of Ridgway, rather than pansy purple or dahlia purple of the same standards as in *O. c. cyanea*, the difference quite evident when the two forms are placed side by side; tegmina with the distal pale pattern more reduced in extent, more regular and less broken up than in *c. cyanea,* proximal third of tegmina with the oblique pale markings much more reduced in size and not as sharply evident.

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[27] This is well shown by Uvarov's 1924 figure 9 D (vide supra).

Measurement (in millimeters) of representatives

	Length of body	Length of pronotum	Length of tegmen	Length of caudal femur
♂, Ekibondo, Belgian Congo, *type*	60.5	14	57	31.3
♂, Niangara, Belgian Congo, *paratype*	59.5	14	55.5	31.5
♂, Faradje, Belgian Congo, *paratype*	47.7	11 6	47	27
♂, Faradje, Belgian Congo, *paratype*	59.5	14	56	32.5
♂, Entebbe, Uganda, *paratype*	52	12.5	47.5	27.5
♂, Entebbe, Uganda, *paratype*	56.5	13.3	52.5	30
♀, Niangara, Belgian Congo, *paratype*	68.5	16	65	36
♀, Niangara, Belgian Congo, *allotype*	77.5	17.8	75	42
♀, Faradje, Belgian Congo, *paratype*	59.5	16	66	36
♀, Faradje, Belgian Congo, *paratype*	75	16.5	67.5	38
♀, Mawokota, Uganda, *paratype*	68	17.3	64	36.5
♀, Bweya, Uganda, *paratype*	71	17.2	65	38.5
♀, Nairobi, Kenya Colony	78.5 [28]	17.5	69	40
♀, Goungouru, Middle Congo	64	16	62	36

Variation. — The above table of measurements gives the range in size encountered in the present series. While the whole representation (32 specimens) is quite consistent in the degree of elevation and the arcuation of the median carina of the pronotum, one of the chief characteristics of this subspecies, there is an appreciable amount of variation in the extent to which the carina is incrassate and thickened. In the series from Faradje alone there is seen, in both sexes, to be a very considerable range of emphasis in this respect, in the maximum extreme the carina being subtumid, thicker and more rounded in cross-section than in the opposite condition. In both, however, the profile is the same, although the width of the pale median bar on the carina varies distinctly with the thickening of the structure. The caudal angle of the pronotal disk varies somewhat in its exact degree, and also in the sharpness of the immediate angle itself, although in the majority of the individuals seen the angle is definitely as described from the type of *O. c. imperialis*.

Except in a few specimens which have been poorly preserved and thus virtually lost the coloring of the wing-disk, and a few others which probably were teneral when captured, and in consequence have this coloration very pale, the shade of the wing-disk remains uniform in the series. The reduction and simplification of the pale pattern distad on the tegmina, as contrasted with the condition of this area in *O. c. cyanea*, is evident in by

[28] Abdomen unusually extended.

far the great majority of the specimens of *c. imperialis* examined, although an occasional one, as a female from Faradje, Belgian Congo, and a male from Entebbe, Uganda, have this portion of the pale pattern almost as complex and broken-up as in *O. c. cyanea*. There is an appreciable amount of purely individual variation in the tone of the base dark color of the body and tegmina, which may range from bister to definitely dark fuscous.

Paratypic series.—I have selected as paratypes three males and three females from Niangara, Uele District, Belgian Congo, bearing the same data as the allotype; nine males and seven females from Faradje, Uele District, Belgian Congo, taken December 12, 1912 to January 1, 1913 by Lang and Chapin, these from the collection of the American Museum of Natural History and now in part in that of the Academy of Natural Sciences of Philadelphia; and two males from Entebbe and one female each from Mawokota and Bweya, Uganda, in the Hebard Collection.

Distribution.—The material before me shows that this well-marked subspecies ranges from as far west as the Sanga River region of Middle Congo (Goungouru) eastward to the region of the Great Lakes and into Kenya Colony at least as far as Nairobi. Uvarov's record of *O. cyanea orientalis* (not of Sjöstedt) from the Upper Sanga is doubtless this form, which most probably extends into parts of the Cameroons. Ignacio Bolívar's report of *Locusta cyanea* from Harar and Bourka, Ethiopia[29] also very probably refers to *O. c. imperialis*. Thus, except at the eastern limits of its distribution, this subspecies is an inhabitant of the northern margin of the forested area and the adjacent savanna district in both the Belgian Congo and Middle Congo. Eastward it extends at fair elevations to central Kenya (Nairobi) and extreme eastern Ethiopia (Harar).

Specimens examined: 32; 16 ♂, 16 ♀.

FRENCH EQUATORIAL AFRICA: Goungouru, 15 miles N. of Nola, Middle Congo, elev. 2060 feet; XI, 7, 1934; (George Vanderbilt African Expedition of 1934; J. A. G. Rehn); 1 ♀; [A.N.S.P.].

BELGIAN CONGO: Niangara, Uele District; XI, 8–XII, 1910; (Lang and Chapin); 2 ♂ (*paratypes*), 4 ♀ (*allotype* and *paratypes*); [A.M.N.H. and A.N.S.P.]. Ekibondo, between Niangara and Dungu, Uele District, elev. 2650 feet; IX, 30, 1934; (George Vanderbilt African Expedition of 1934; J. A. G. Rehn); 1 ♂ (*type*); [A.N.S.P.]. Faradje, Uele District; XII, 12, 1912–I, 1, 1913; (Lang and Chapin); 10 ♂ (*paratypes*), 7 ♀ (*paratypes*); [A.M.N.H. and A.N.S.P.]. Garamba, Uele District; I, 1912; (Lang and Chapin); 1 ♂; [A.N.S.P.].

UGANDA PROTECTORATE: Entebbe; XI, 1912 and III, 15, 1913; (C. C. Gowdey); 2 ♂ (*paratypes*); [Hebard Cln.]. Mawokota; V, 2, 1913; (C.

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[29] In Voy. M. le Baron Maurice de Rothschild en Éthiopie et en Afrique Orientale Anglaise (1904-1905). Résultats Scientifiques. Animaux Articulés, Part I, p. 187. Atlas, pl. Io2 (XVIII), 1922.

C. Gowdey); 1 ♀ (*paratype*); [Hebard Cln.]. Bweya; V, 17, 1913; (C. C. Gowdey); 1 ♀ (*paratype*); [Hebard Cln.].

TANGANYIKA TERRITORY: Bukoba, Lake Victoria; (Dr. Eggel); 1 ♀; [A.N.S.P.].[30]

KENYA COLONY: Nairobi; VIII, 5, 1919; (Loveridge); 1 ♀; [M.C.Z.].

Ornithacris orientalis (Sjöstedt) Figs. 5-6; pl. 15, fig. 15.

1909. *Acridium magnificum* var. *orientalis* Sjöstedt, Wiss. Ergebn. Schw. Zool. Exped. Kilimandsch. Meru, 17, Orth., 7, Acrid., pp. 183, 186. [♂, ♀; Kibonoto, Kilimanjaro, East Africa.]

1924. *Ornithacris cyanea pictula* Uvarov, Ann. and Mag. Nat. Hist., (9) XIII, p. 123, fig. 9 B. (In part.[31])

1942. *O[rnithacris] cyanea rosea* Uvarov, Ann. and Mag. Nat. Hist., (11) IX, pp. 136, 139. [♂ (type), ♀: Durban (= Port Natal), Natal; Zoutpansberg and Barberton, Transvaal; Bechuanaland; Delagoa Bay, Portuguese East Africa; Bukoba, Morogoro (type locality), Kigoma, Manda, Tindiga [32] and Chilangali, Tanganyika Territory; Kota Kota, Nyasaland.[33]]

In both of his studies of this genus Uvarov has interpreted Sjöstedt's *orientalis* as a form with a purple wing-disk. Sjöstedt in describing *orientalis* contrasted it with *magnifica*, which he says has " cinnaberotten " hind wings, while *orientalis* has them " viel violetter, wein-oder anilin rot," and in his key to the acridid forms treated in this Kilimanjaro report he gives as characteristic of *orientalis*, " das ganze Basalfeld der Hinterflugel rot." It is clearly evident from this that Sjöstedt did not consider the wing-disk of his new form to be truly violet, but only more violet, wine or aniline red than the strongly cinnabar wing-disk of *magnifica*. The series now before me support quite fully this interpretation of *orientalis*, rendering superfluous Uvarov's recently erected *rosea*.

This quite distinct species has the wine red of the wing-disk in strong contrast with the cinnabar disks of the members of the *pictula* section of the genus, and it is readily recognizable by this coloration alone. The pronotum is definitely less compressed than in *p. magnifica* and the arcuation of its crest is much less decided, while the caudal margin of the pronotal disk is rectangulate in the male and obtuse-angulate with the immediate angle usually rounded in the female.[34] The tegmina are proportionately

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[30] This specimen was recorded by me in 1914 as *Locusta magnifica* var. *orientalis* (see Wissensch. Ergebn. Deutschen Zent.-Afr.-Exped., 1907-1908, V, Zool. III, lief. 1, p. 108). The other specimens recorded at the same time as *orientalis* are not at present available for re-examination.

[31] In his recent paper Uvarov (Ann. and Mag. Nat. Hist., (11) IX, p. 139, (1942)) regards Miller's 1929 interpretation of Walker's *pictula* as based on this form, and therefore distinct from the true South African *pictula*.

[32] Apparently this is a transcriptional error for the well-known locality Singida.

[33] The purple-winged specimen labelled " Congo " referred to *O. c. rosea* by Uvarov, probably represents *O. c. cyanea* lacking pale lateral pronotal bars.

[34] The female from the Ruwuwu Valley, Urundi, has the immediate angle sharper than in any of the other females seen. The nearest approach is in the female from Natal.

longer and narrower than in *p. magnifica* and the wings are similarly more attenuate, with the anterior field narrower, while the axillary field has the distal margin less strongly lobate arcuate. The tegminal pattern is more extensive and complex than in the *pictula* or *cyanea* assemblages, with a greater number of diagonal pale cross-bars in the proximal half, and a more ramifying series of pale anastomosings in the distal section.

The wing-disk tone is paler in the two males from Adams Mission Station, Natal and Conjeni, Zululand, and in one of the two males from Lourenço Marques, Portuguese East Africa, than in the others, but this is probably due to a subteneral condition when the specimens were killed. All seen of this species except the single female from the Ruwuwu Valley, Urundi, show the pale postocular bars on the pronotum. The Chai Chai series shows there is some little individual variation, particularly in the female sex, in the width of the pale medio-longitudinal bar on the pronotal crest.

In size *orientalis* is relatively uniform, particularly at individual localities, as the measurements (in millimeters) of the following representative specimens show. I have given the greatest width of the combined mediastine and discoidal fields of the tegmina for comparison with this in related forms.

	Length of body	Length of pronotum	Length of tegmen	Greatest width of combined mediastine and discoidal fields of tegmen	Length of caudal femur
♂, Chai Chai, Port. E. Africa	54.5	13	52+	8	31
♂, Chai Chai, Port. E. Africa	60	14	55.5	9.1	32
♂, Lourenço Marques, Port. E. Africa	54.5	12.8	55	8.2	31.5
♂, Lourenço Marques, Port. E. Africa	58.7	14	55.5	8.5	33.5
♂, Conjeni, Zululand	55.5	13	54	8.4	31
♂, Adams Mission Station, Natal	51	12	51	8.8	29.5
♀, Ruwuwu Valley, Urundi, Belg. Congo	72.5	16.5	70.5	10.2	39.8
♀, Abercorn, Northern Rhodesia	72	18	66+	11	43
♀, Zimbabwe, Southern Rhodesia	81 [35]	15.5	68	10.8	38.5
♀, Pretoria, Transvaal	72	16.5	67.5	11	41
♀, Chai Chai, Port. E. Africa	70.5	17	68+	10.5	40.8
♀, Chai Chai, Port. E. Africa	75	18.8	77	11	45
♀, Natal	67	17	66.5	10.5	41.5

[35] Abdomen abnormally extended.

In distribution this quite distinctive species extends from Urundi (Ruwuwu Valley), Belgian Congo, and Bukoba, Tanganyika Territory, on Lake Victoria, southward across at least western and central Tanganyika Territory, extreme Northern Rhodesia (Abercorn), Nyasaland (Kota Kota), eastern Southern Rhodesia (Zimbabwe), Bechuanaland (no exact locality), eastern and central Transvaal (Zoutpansberg, Barberton and Pretoria) and at least the coastal area of southern Portuguese East Africa (Chai Chai and Lourenço Marques), Zululand (Conjeni) and Natal (Durban and Adams Mission Station). Its distribution overlaps that of the forms of *O. cyanea* to the north, that of *O. p. magnifica* along much of the western border of its range, and interdigitates with the habitat of *O. p. pictula* at its southern limit. It does not intergrade, as far as I can determine, with any of these forms.

Specimens examined: 20; 9 ♂, 11 ♀.

BELGIAN CONGO (URUNDI): Ruwuwu Valley, elevation 1700 meters; IX, 24, 1911; (H. Meyer); 1 ♀; [Berlin Zool. Museum].

NORTHERN RHODESIA: Abercorn, Tanganyika District; VII, 1930; (P. Evans); 1 ♀; [A.N.S.P.].

SOUTHERN RHODESIA: Zimbabwe Ruins; VIII, 23, 1930; (De Schauensee Exped.); 1 ♀; [A.N.S.P.].

TRANSVAAL: Pretoria; XI, 24, 1915; (J. W. Hodgson, on veldt grass); 1 ♀; [A.N.S.P.].

PORTUGUESE EAST AFRICA: Chai Chai[36]; VII and VII, 17-19, 1930; (in part taken by J. C. Faure and W. Roux); 5 ♂, 6 ♀; [A.N.S.P. and Univ. of Pretoria]. Lourenço Marques; VII, 12, 1930; 1 ♂; [Univ. of Pretoria]: 1920; (C. H. Lankester); 1 ♂; [A.N.S.P.].

ZULULAND: Conjeni; III, 22, 1927; 1 ♀; [A.N.S.P.].

NATAL: Adams Mission Station: IV, 11, 1917; (S. G. Rich); 1 ♂; [A.N.S.P.]. No exact locality; 1 ♀; [M.C.Z.].

Ornithacris pictula pictula (Walker) Fig. 9; pl. 15, fig. 16; pl. 18, figs. 31-34.

1870. *Cyrtacanthacris pictula* Walker, Catal. Derm. Salt. Brit. Mus., III, p. 562. [♂; South Africa.][37]

1924. *Ornithacris cyanea pictula* Uvarov, Ann. and Mag. Nat. Hist., (9) XIII, pp. 10, 12.

1942. *O[rnithacris] cyanea pictula* Uvarov, Ann. and Mag. Nat. Hist., (11) XI, pp. 136, 137.

At first glance it is difficult to appreciate that typical *pictula* from the Cape Province and the two other subspecies here associated with it in a

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[36] This locality is now known officially as Vila João Belo, and is situated on the Limpopo River a short distance above its mouth. Position approximately 25°S., 32°49′E.

[37] Uvarov in his first study of the genus (vide supra, p. 12) gives *Cyrtacanthacris internexa* Walker as in part a synonym of *pictula*. Walker's name *internexa* (Catal. Derm. Salt. Brit. Mus., IV, p. 613, (1870)) was applied to a previous interpretation of *C. ranacea*, and is entirely without description except for the few features which may be gleaned from his preceding and very sketchy key to African and Arabian Cyrtacanthacri. Following this key we find that *internexa* is said to have the "hind wings

single specific unit are so closely related. The evidence of the material before me is, however, conclusive on that point.

Cape Province representatives of this subspecies are quite small, in fact the smallest individuals of *Ornithacris* seen, while northward there is a gradual increase in size, although even Transvaal material remains typical of this subspecies in all other respects. This size increase northward is evident from the following measurements (in millimeters) of representative individuals of this form now before me.

	Length of body	Length of pronotum	Length of tegmen	Greatest width of combined mediastine and discoidal fields of tegmen	Length of caudal femur
♂, Between Knysna and George, Cape Province	41.5	11.6	40.5	6.8	23.8
♂, Between Knysna and George, Cape Province	38.2	11.6	39	6.8	24.7
♂, Between Knysna and George, Cape Province	44.5	12.5	40	7	25.8
♂, Orange Free State	45.2	12	42	7	26
♂, Hluhluwe Game Reserve, Zululand	46.6	12.5	44.5	8	27.5
♂, Waterberg, Transvaal	48	11.2	43.8	7.9	25
♂, N'Kate, Makarikari, Bechuanaland Protectorate	56	11.8+	49	8	28.2
♀, Pretoria, Transvaal	71	16	61	10.5	35.5
♀, "Transvaal"	64	17	58	11.2	37.3
♀, East of Tsotsorogo Pan, Bechuanaland Protectorate	65	16	62	10.8	38.6

Of the specimens of *O. p. pictula* now before me the tone of the wing-disk is light coral red in the Cape Province, Orange River Colony and Transvaal males seen. The male from N'Kate, Bechuanaland has this deeper in tone, nearer coral red, while in a female from extreme northern Bechuanaland (east of Tsotsorogo Pan) the disk is as rich as pale scarlet red. In two of the Transvaal females the wing-disks are nearer carnelian

not red," hind tibiae "not blue," "spines of hind tibiae white," "hind wings toward the base with yellow veins," and "fore keel of the prothorax low," to mention those features which would have any noteworthy or selective value. Of these the wing and prothoracic characters certainly would not apply to *O. p. pictula*, which has coral red wings without yellow veins, and the median carina of the pronotum is quite definitely high. Walker's proposal of *internexa* merely refers back to his listing of material under the species *ranacea* (Catal. Derm. Salt. Brit. Mus., III, p. 556, (1870)), and apparently was intended to apply to the African material—which is all there listed—as he says *ranacea* "inhabits Hindostan." Uvarov considers that *internexa* is also in part a synonym of *Cyrtacanthacris tatarica* and *C. aeruginosa* (see Ann. and Mag. Nat. Hist., (9) XIV, pp. 96 and 98, (1924)), but certainly Walker's key features would not apply to *O. p. pictula*, regardless of what specific units may be encompassed in his listing of African specimens under *ranacea*.

red (of Ridgway), while that of the female labelled merely "Transvaal" is light coral red.

All of the specimens of *O. p. pictula* before me have well marked and sharply contrasted paired pale humeral bars on the pronotum.

In his 1942 revised concept of this form—considered by him to be a subspecies of *O. cyanea*—Uvarov gives its range as extending from the Cape Province (specifically Knysna) northward across the Orange River Colony to the region of Pretoria, Transvaal. The present information shows that typical *pictula* reaches at least to the Waterberg District of the northern Transvaal and across the Bechuanaland Protectorate to its extreme northern part (east of Tsotsorogo Pan), while in the coastal area it extends northeastward at least as far as Zululand (Hluhluwe Game Reserve), where it occurs in the same territory as the largely more northern and specifically distinct *O. orientalis*.

Specimens examined: 11; 7 ♂, 4 ♀.

CAPE PROVINCE: Between Knysna and George; IV, 6, 1939; (E. R. Helwig); 3 ♂; [A.N.S.P.].

ORANGE FREE STATE: 1902; (G. E. H. B[arrett]-Hamilton); 1 ♂; [Hebard Cln.].[38]

ZULULAND: Hluhluwe Game Reserve, Hlabisa District; VII, 14, 1939; (R. H. N. Smithers); 1 ♂; [A.N.S.P.].

TRANSVAAL: Waterberg District; 1898-1899; (v. Jutrzencka); 1 ♂; [Transv. Mus.]. Pretoria; (W. D. D[istant]); 1 ♀; [Hebard Cln.[39]]. Pyramids, near Pretoria; IX, 25, 1932; 1 ♀; [Univ. of Pretoria]. No exact data; 1 ♀; [A.N.S.P.].

BECHUANALAND PROTECTORATE: Twenty miles east of Tsotsorogo Pan; VI, 17, 1930; (Vernay-Lang Kalahari Exped.); 1 ♀; [Transv. Mus.]. N'Kate, Makarikari; VIII, 6-23, 1930; (Vernay-Lang Kalahari Exped.); 1 ♂; [A.N.S.P.].

Ornithacris pictula magnifica (I. Bolívar)

Fig. 10; pl. 16, fig. 17; pl. 17, figs. 19-20, 23-24.

1881. *Acridium magnificum* I. Bolívar, Jorn, Sci. Math. Phys. e Nat., Lisboa, VIII, p. 113. [♀; Humbe and Duque du Bragança (latter selected as type locality by Uvarov, 1942), Angola.]

1924. *Ornithacris cyanea magnifica* Uvarov, Ann. and Mag. Nat. Hist., (9) XIII, p. 12, figs. 9A, a.

1942. *O[rnithacris] cyanea magnifica* Uvarov, Ann. and Mag. Nat. Hist., (11) IX, p. 137.

It is evident from the series before me that *magnifica* as understood by Uvarov in 1924 and 1942 really embraces two subspecies, one from Angola

[38] This specimen, received in exchange with the British Museum (Natural History), was determined and recorded by Uvarov as *O. cyanea pictula*.

[39] This specimen, like that from the Orange Free State, was received in exchange with the British Museum (Natural History), determined by Uvarov as *O. cyanea pictula*.

and the southwestern Belgian Congo, the other occurring in central and east-central African areas. It is not possible, without examining the material studied by that author, to say definitely to which of these units certain of his representations should be referred. Certainly true *magnifica* would be that from his Angolan localities, while probably most of those in Northern and Southern Rhodesia, and almost certainly all in Tanganyika Territory and Kenya would be represented by *O. p. cruenta*, here described. Uvarov states that material from two Tanganyika Territory localities (Amani and Masilewato, Mgori, 25 miles east of Singida) and two in Kenya (Chyulu Hills and Nairobi) have rose-colored wings " and are regarded as transitional to subsp. *orientalis* " (the latter used by him for what I am here calling *O. cyanea imperialis*). Structural features such as the less compressed pronotum, with its lower crest, and the definitely narrower tegmina will at once distinguish the forms of *O. cyanea* from *O. pictula cruenta*. The more rose-tinged (i.e. pale carmine) wing-disk is distinctive of *O. pictula cruenta* when compared with *O. p. magnifica*, and the two should be readily separable by the features here given in the key to the forms.

The subgenital plate of the male sex is of essentially the same form in both *O. p. magnifica* and *O. p. cruenta*, and definitely more elongate and more acutely pointed than in *O. p. pictula*, as shown in the accompanying figures.

Of the series of *O. p. magnifica* now before me one of the three females from Palavange, Angola, and the single male from the same locality, definitely show paired lateral pale bars on the pronotum, and they are also strongly marked in the atypical male from Windhoek, Southwest Africa. They appear to have been present originally in the Loanda female which has been discolored since. The remaining two Palavange females have their pronota somewhat discolored from desiccation and in life may have possessed pale bars. The Kimuenza, Belgian Congo male, which is perfectly preserved, shows no traces of pale lateral pronotal bars.

Representative individuals measure (in millimeters) as follows:

	Length of body	Length of pronotum	Length of tegmen	Greatest width of combined mediastine and discoidal fields of tegmen	Length of caudal femur
Typical *O. p. magnifica*					
♂, Kimuenza, Belgian Congo	58	14.5	53.5	9	31
♂, Palavange, Angola..	54.5	14.6	57.5	9.5	30.5
♀, Palavange, Angola..	72	18.4	68.5	11.2	39
Atypical *O. p. magnifica*					
♂, Windhoek, Southwest Africa	59	13.5	56.5	9.2	33.5

The wing-disk in all the material here referred to *O. p. magnifica* is uniform in color and definitely scarlet (equalling the classic term cinnabar), except that in the atypical Windhoek male the disk color is very pale and weak, as may be expected in a very arid region, and the Loanda individual has had the wing-disk color destroyed by alcoholic immersion.

It is evident from present material and correlated previously published information that typical *O. p. magnifica* is distributed from southern Angola (Humbe) northward to at least the lower Congo (Kimuenza, Belgian Congo[40]; Brazzaville and Musana, 120 kilometers west of that place, Middle Congo, French Equatorial Africa), and to the eastward an undetermined distance to its area of intergradation with *O. p. cruenta.* Exactly where this passage takes place is not clear from the limited material now available, but apparently it is in eastern Angola, the western part of Northern Rhodesia or the southern areas of the Belgian Congo. As we have already noted *O. p. pictula* is typical as far north as the northern part of Bechuanaland Protectorate (Tsotsorogo Pan). Southward of Angola *O. p. magnifica* extends atypically at least as far as Windhoek, Southwest Africa.

Specimens examined: 7; 3 ♂, 4 ♀.

Typical *O. p. magnifica*

BELGIAN CONGO: Kimuenza, District of Lower Congo; IX, 27-28, 1910; (Arnold Schultze); 1 ♂; [Hamburg Museum].

ANGOLA: Palavange[41]; XI, 2, 1930; (Second Prentiss Gray African Expedition; H. T. Green); 1 ♂, 3 ♀; [A.N.S.P.]. Loanda; (H. Chatelain); 1 ♀; [U.S.N.M.].

Atypical *O. p. magnifica*

SOUTHWEST AFRICA: Windhoek; 1 ♂; [A.N.S.P.].

Ornithacris pictula cruenta[42] new subspecies

Pl. 16, fig. 18; pl. 17, figs. 21-22, 25-26.

1924. *Ornithacris cyanea magnifica* Uvarov, Ann. and Mag. Nat. Hist., (9) XIII, p. 12. (In part.)
1929. *Ornithacris cyanea magnifica* Miller, Trans. Entom. Soc. London, 1929, p. 84. (Not *Acridium magnificum* I. Bolívar.) [Uluguru Mountains, Tubugwe (Dodoma District), Mkalama and Kilosa, Tanganyika Territory.]
1942. *O[rnithacris] cyanea magnifica* Uvarov, Ann. and Mag. Nat. Hist., (11) IX, p. 137. (In part.)

As shown on a preceding page under *O. p. magnifica* two subspecies are included under the latter name in previously published studies of the genus by Uvarov. Of these the most western is true *magnifica*, while the form

40 This locality is in the District of Lower Congo, a few miles southeast of Kinchasa.

41 Palavange is located between the Cuanza and Luanda Rivers, about 70 miles north of Silva Porto, at an elevation of 4500 feet.

42 In allusion to the color of the wing-disk.

found in Tanganyika Territory and Northern and Southern Rhodesia, and doubtless Kenya as well, is a well-characterized but previously unrecognized subspecies.

When compared with *O. p. pictula* the new form is seen to differ, and to the same extent, in virtually all the features which separate *O. p. magnifica* as well, i. e. larger size, more attenuate form, more pronounced pronotal compression, deeper and richer coloring of the wing-disk and more produced male subgenital plate. When compared with *O. p. magnifica* the present form can at once be separated by the proportionately broader tegmina, which also have the distal half with a less evident or less extensive pale pattern, by the pale carmine instead of scarlet wing-disk, and in the pronotum of the female being more strongly compressed, narrower cephalad and with its median carina in profile less evenly arcuate than in *O. p. magnifica.*

Type.—♀; Abercorn, Tanganyika District, Northern Rhodesia. July, 1930. (Dr. Pole Evans.) [Academy of Natural Sciences of Philadelphia, Type no. 5683.]

The following features are chiefly those of difference from the female of *O. pictula magnifica.*

Size somewhat larger than in *O. p. magnifica;* general form similar.

Pronotum more compressed than in *magnifica* female, particularly cephalad, while the greatest width caudad across the metazonal portion of the disk is subequal to the vertical height of the caudal margin of the lateral lobes, instead of appreciably greater as in *magnifica;* in profile the median carina of the pronotum is not as evenly arcuate as in *p. magnifica,* but has the highest point on the metazona immediately caudad of the principal sulcus, and not at or slightly cephalad of that point as in *magnifica,* while the curve of the outline cephalad of the highest point is straighter ascending and the caudal section is more sigmoidally descending to the level of the caudal margin (see plate 17, figs. 24 and 26) [43]; lateral lobes of the pronotum slightly deeper in proportion to their dorsal length and the caudal margin straighter and more subvertical than in *O. p. magnifica.*

Tegmina very broad (for genus), greatest width, which is at distal third, contained not over $5\frac{1}{2}$ times in tegminal length, as contrasted with six times in *magnifica.*

Caudal femora less attenuate and appreciably stouter than in *O. p. magnifica,* the narrowed pregenicular portion also being shorter and heavier in both dorsal and lateral aspects, the inflated proximal three-fifths actually and proportionately more robust in both aspects than in *magnifica;* genicular lobes fuller and more rounded, the distal margin less subangulate than in *magnifica*: caudal tibiae with marginal spines larger than in *O. p. magnifica.*

Allotype.—♂; Msamwia, South Ufipa, Tanganyika Territory. Elevation, 1850 meters. Late November to early December, 1908. (Fromm.) [Berlin Zoological Museum.]

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[43] The type has the pronotal crest slightly malformed between the first and second transverse sulci, probably due to an injury in early life, so a more normal paratype (that from Zimbabwe) has been figured.

The following features are of difference from the male sex of *O. p. magnifica* or from the above description of the female of *O. p. cruenta.*

Pronotum showing much less difference in the degree of compression than in the female, the outline of the median carina, however, as in the female.

Tegmina distinctly broader than in the male sex of *O. p. magnifica,* greatest breadth contained not over five times in their length, as against $5\frac{1}{2}$ times in the male of *magnifica.*

Subgenital plate of male essentially as in the male of *O. p. magnifica,* agreeing in the degree of its production.

Caudal femora as in female—shorter and less attenuate than in male of *magnifica.*

Measurements (in millimeters)

	Length of body	Length of pronotum	Length of tegmen	Greatest width of combined mediastine and discoidal fields of tegmen	Length of caudal femur
♂, Msamwia, Tanganyika, *allotype*	52	12.6	50	9.2	28.2
♀, Abercorn, No. Rhodesia, *type*	71.5	18.2	75.5	12.5	41
♀, Zimbabwe, So. Rhodesia, *paratype* ...	78	20.8	76.5	12.3	46
♀, Mutambara, So. Rhodesia, *paratype*	78.5	19.5	77	12.8	45.3

Coloration.—The pattern of *O. p. cruenta* is essentially the same as in *O. p. magnifica,* except that the distal half of the tegmina has the pale oblique areas less evident and reduced to relatively short streaks or even spots, and always less numerous than in *magnifica;* in addition the usual proximal pale spot, or spots, in the discoidal field is more reduced than in *magnifica,* or even lacking. The general effect of the tegminal pattern in *O. p. cruenta* is to center the eye on the two median oblique pale bars, which are always marked, the others, aside from the pale anal stripe, which also occurs in *magnifica,* being definitely subordinate to these.

In tone the wing-disk is pale carmine,[44] as opposed to scarlet or scarlet-red in *O. p. magnifica.* The pronotum in its darker color averages less fuscous than in *magnifica,* and is nearer sanford's brown to auburn. The pattern of the paginae of the caudal femora is less definitely dark pencilled or contrasted in *cruenta* than in *O. p. magnifica,* although the color tone of the caudal tibiae is essentially the same.

Paratypes.—I am considering all material seen in addition to the type and allotype, i.e. one female each from Mutambara, Southern Rhodesia and Zimbabwe in the same territory, as paratypes.

Distribution.—Material now before me shows that *O. p. cruenta* occurs over the more elevated areas extending from the eastern portion of Southern

[44] Even full carmine, of Ridgway, in the Mutambara female.

Rhodesia (Ruins of Zimbabwe and Mutambara [45]) northward to extreme northeastern Northern Rhodesia (Abercorn) and southern Tanganyika Territory (Msamwia, South Ufipa).

In addition there is every probability that material recorded in 1924 and 1942 by Uvarov as *magnifica* from Leydsdorf, northern Transvaal; Muza, Zambesi; Kapiri and Sakania, Katanga, Belgian Congo; numerous localities distributed over Tanganyika Territory, reaching northeastward to the Usambara Mountains (Amani), and several in Kenya (Chyulu Hills and Nairobi) represent this subspecies. As stated under *O. p. magnifica*, we are unable to say exactly where the area of intergradation with *O. p. magnifica* is located, but probably material from the southcentral Belgian Congo will show this passage.

Remarks.—This is the largest and most striking form of the genus, and its separation from *O. p. magnifica* is necessary if a uniform ratio of values in the genus is to be maintained. The relatively broad tegmina, with their reduced but even more emphasized pattern, will at once distinguish typical material of this subspecies from that of *O. p. magnifica.*

Specimens examined: 4; 1 ♂, 3 ♀.

TANGANYIKA TERRITORY: Msamwia, South Ufipa, 1850 meters elevation; late XI to early XII, 1908; (Fromm); 1 ♂; (*allotype*); [Berlin Zool. Mus.].

NORTHERN RHODESIA: Abercorn, Tanganyika District; VII, 1930; (Dr. Pole Evans); 1 ♀ (*type*); [A.N.S.P.].

SOUTHERN RHODESIA: Mutambara [46]; XI, 1, 1921; (Mrs. J. M. Springer); 1 ♀ (*paratype*); [Hebard Cln.]. Ruins of Zimbabwe; VIII, 3, 1930; (Vernay-Lang Expedition; on grassy hills); 1 ♀ (*paratype*); [Transv. Mus.].

EXPLANATION OF PLATES 13 TO 18

PLATE 13.

FIG. 11.—*Ornithacris turbida turbida* (Walker). Female. Yapi, Gold Coast. Dorsal view. (Natural size.)

FIG. 12.—*Ornithacris turbida cavroisi* (Finot). Female. Bibianaha, Gold Coast. Dorsal view. (Natural size.)

PLATE 14.

FIG. 13.—*Ornithacris cyanea cyanea* (Stoll). Female. Russisi River, southwest Urundi, Belgian Congo. Dorsal view. (Natural size.)

FIG. 14.—*Ornithacris cyanea imperialis* new subspecies. Female (allotype). Niangara, Uele District, Belgian Congo. Dorsal view. (Natural size.)

PLATE 15.

FIG. 15.—*Ornithacris orientalis* (Sjöstedt). Female. Chai Chai, Portuguese East Africa. Dorsal view. (Natural size.)

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[45] Mutambara is a mission station forty to fifty miles south of Umtali, between the latter and the settlement of Melsetter. It is not shown on any standard map. and its position is given from notes made by the collector.

[46] See footnote no. 45.

FIG. 16.—*Ornithacris pictula pictula* (Walker). Male. Between Knysna and George. Cape Province. Dorsal view. (Natural size.)

PLATE 16.

FIG. 17.—*Ornithacris pictula magnifica* (I. Bolívar). Female. Palavange, Angola. Dorsal view. (Natural size.)

FIG. 18.—*Ornithacris pictula cruenta* new subspecies. Female (paratype). Tsotsorogo Pan, Bechuanaland Protectorate. Dorsal view. (Natural size.)

PLATE 17.

FIGS. 19 and 20.—*Ornithacris pictula magnifica* (I. Bolívar). Male. Kimuenza, Lower Congo District, Belgian Congo. Dorsal and lateral views of head and pronotum. (× 2.)

FIGS. 21 and 22.—*Ornithacris pictula cruenta* new subspecies. Male. Msamwia, south Ufipa, Tanganyika Territory. Dorsal and lateral views of head and pronotum. (× 2.)

FIGS. 23 and 24.—*Ornithacris pictula magnifica* (I. Bolívar). Female. Palavange, Angola. Dorsal and lateral views of head and pronotum. (× 2.)

FIGS. 25 and 26.—*Ornithacris pictula cruenta* new subspecies. Female (paratype). Tsotsorogo Pan, Bechuanaland Protectorate. Lateral and dorsal views of head and pronotum. (× 2.)

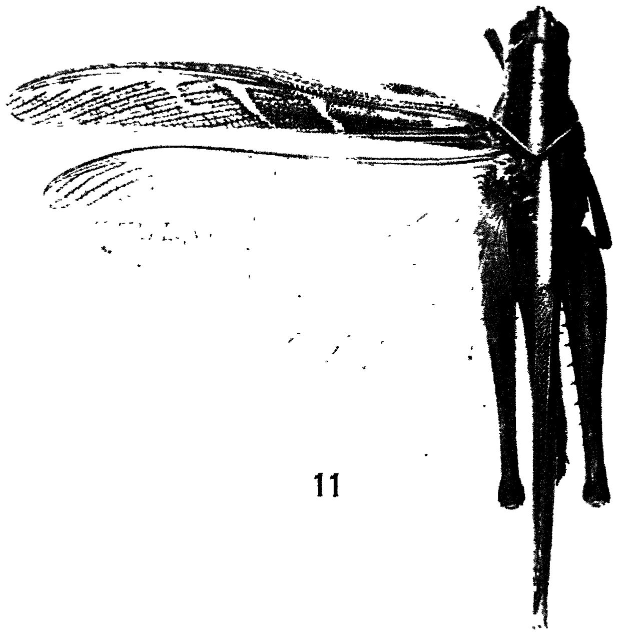
PLATE 18.

FIGS. 27 and 28.—*Ornithacris turbida turbida* (Walker). Female. Yapi, Gold Coast. Dorsal and lateral views of head and pronotum. (× 2.)

FIGS. 29 and 30.—*Ornithacris turbida cavroisi* (Finot). Female. Bibianaha, Gold Coast. Dorsal and lateral views of head and pronotum. (× 2.)

FIGS. 31 and 32.—*Ornithacris pictula pictula* (Walker). Male. Between Knysna and George, Cape Province. Dorsal and lateral views of head and pronotum. (× 2.)

FIGS. 33 and 34.—*Ornithacris pictula pictula* (Walker). Female. Pretoria, Transvaal. Dorsal and lateral views of head and pronotum. (× 2.)



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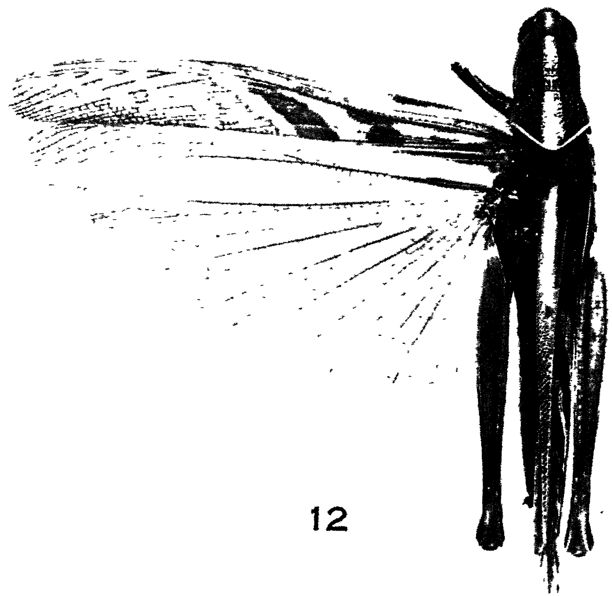

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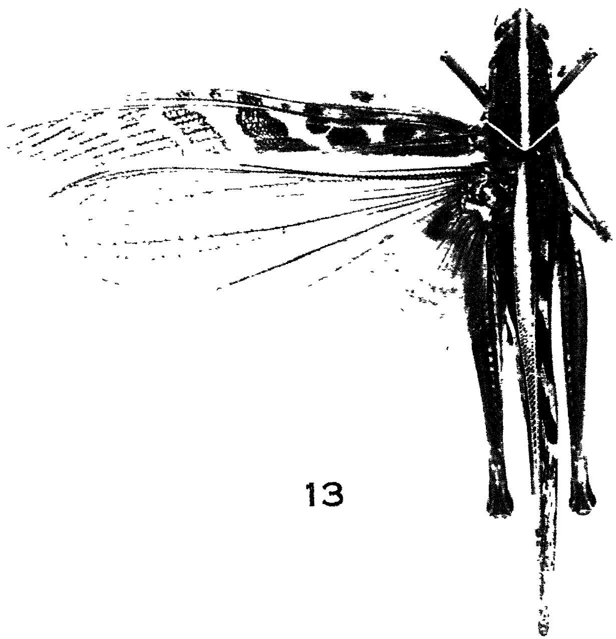
REHN: THE BIRD-LOCUSTS OF THE AFRICAN GENUS ORNITHACRIS
(ORTHOPTERA; ACRIDIDAE; CYRTACANTHACRIDINAE)



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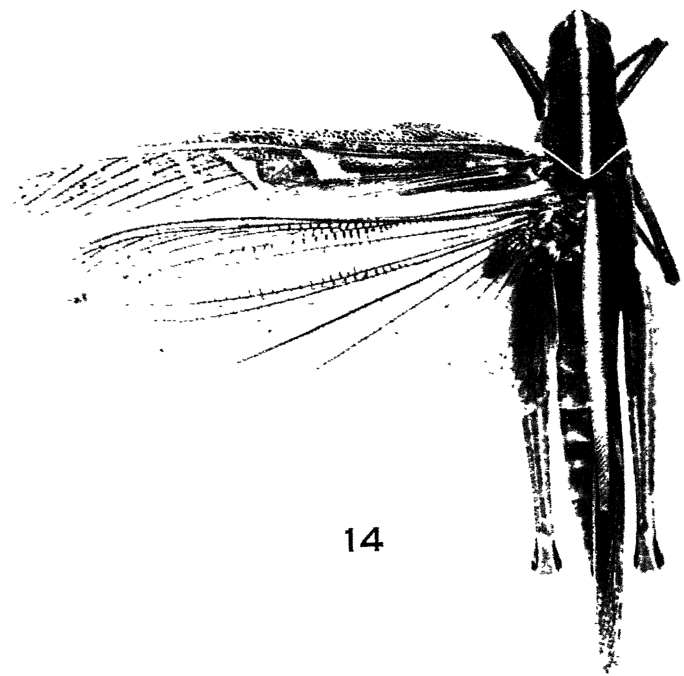

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REHN: THE BIRD-LOCUSTS OF THE AFRICAN GENUS ORNITHACRIS
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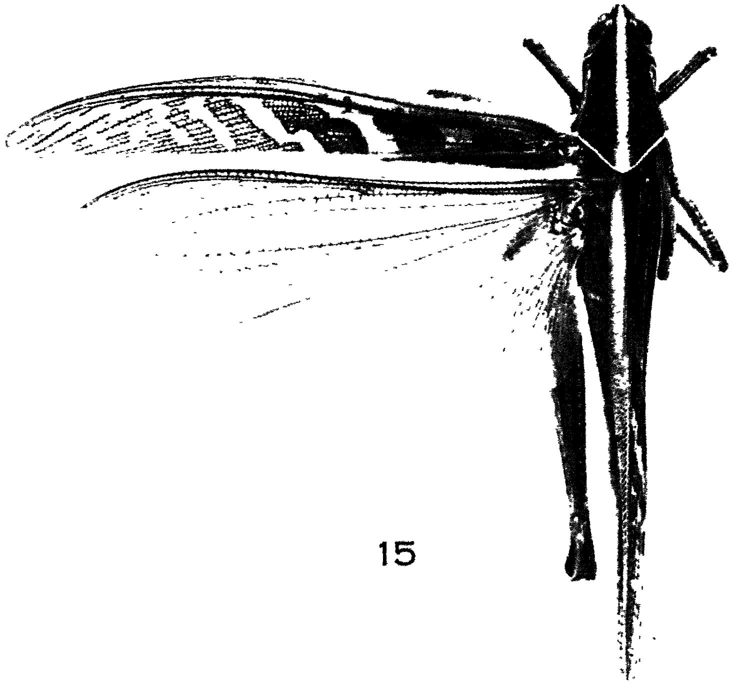

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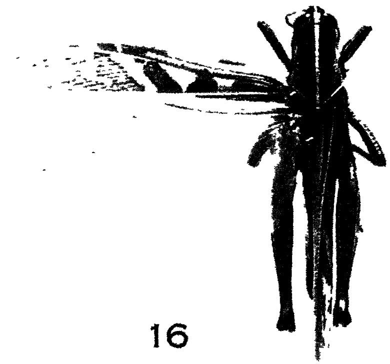

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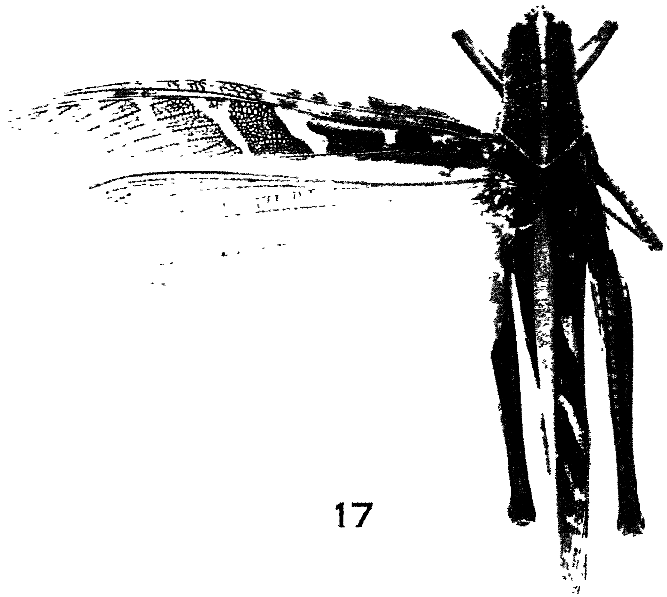
REHN: THE BIRD-LOCUSTS OF THE AFRICAN GENUS ORNITHACRIS
(ORTHOPTERA; ACRIDIDAE; CYRTACANTHACRIDINAE)



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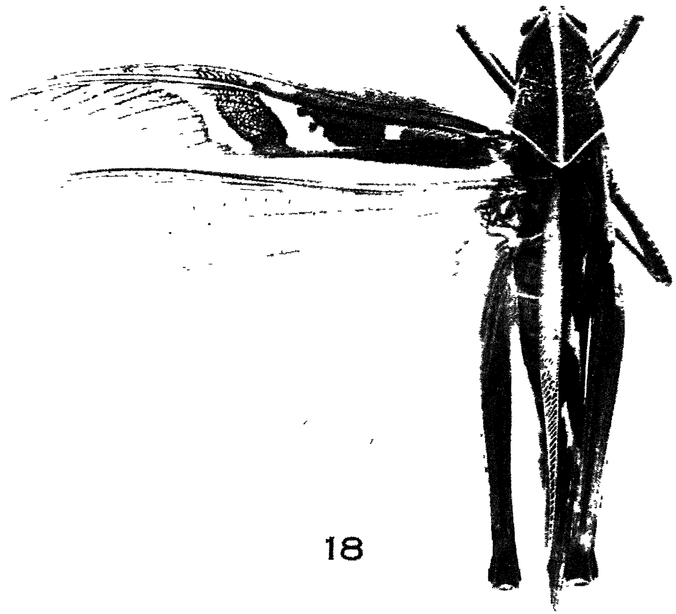

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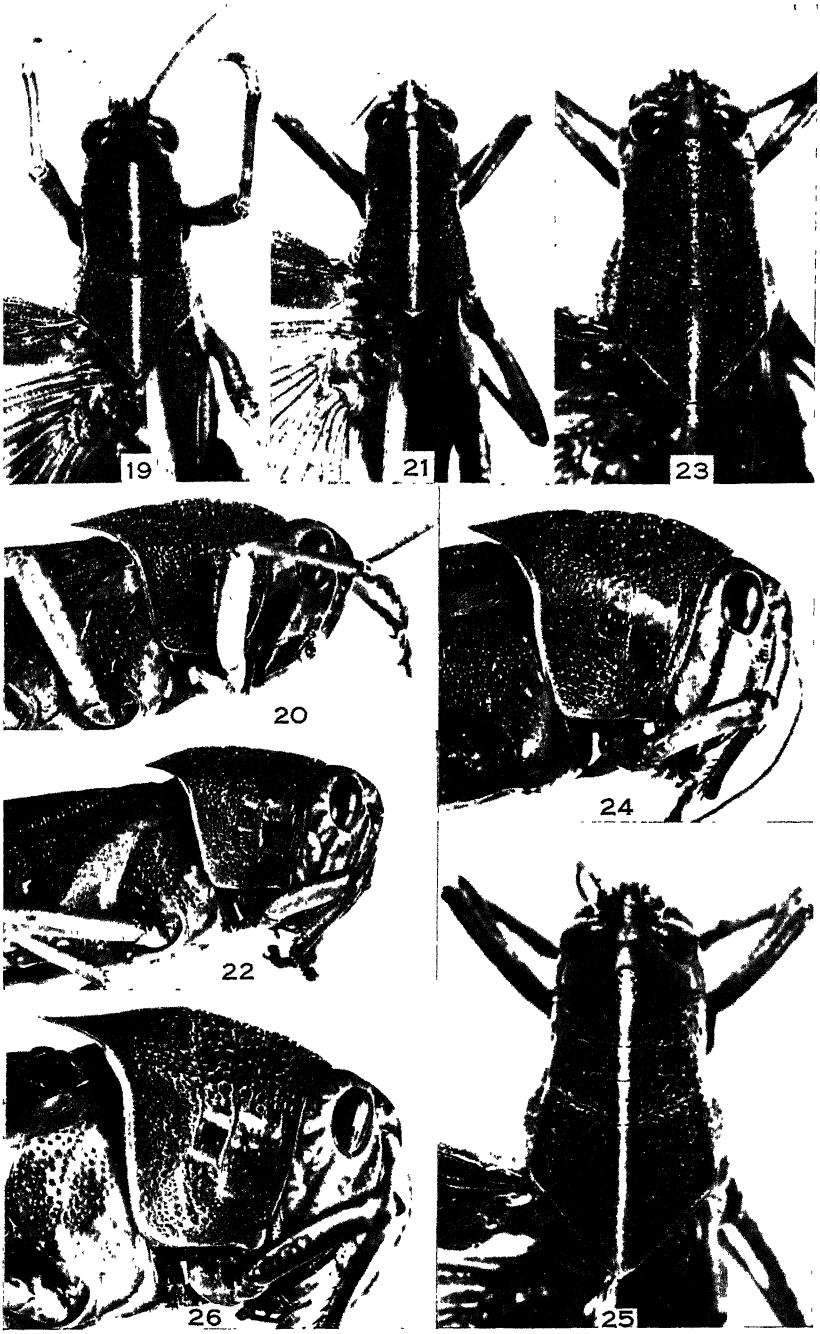
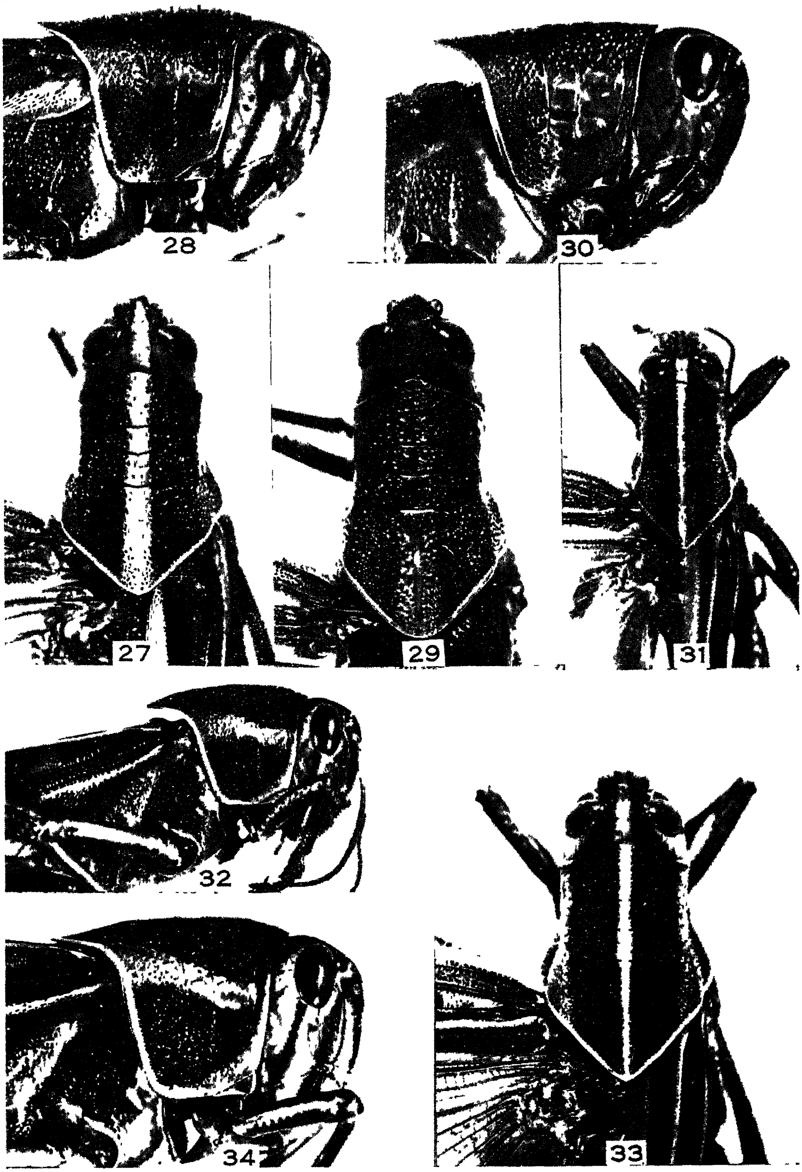
REHN: THE BIRD-LOCUSTS OF THE AFRICAN GENUS ORNITHACRIS
(ORTHOPTERA; ACRIDIDAE; CYRTACANTHACRIDINAE)



REHN: THE BIRD-LOCUSTS OF THE AFRICAN GENUS ORNITHACRIS
(ORTHOPTERA; ACRIDIDAE; CYRTACANTHACRIDINAE)



REHN: THE BIRD-LOCUSTS OF THE AFRICAN GENUS ORNITHACRIS
(ORTHOPTERA; ACRIDIDAE; CYRTACANTHACRIDINAE)

HAMULUS, "FALCULA", AND OTHER CRETACEOUS TUBICOLA OF NEW JERSEY

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Hamulus

The genus *Hamulus* was proposed by Morton [1] for small, unattached, tapering, curved calcareous tubes, with external ribs, distinct "volutions", and circular apertures, found in Cretaceous deposits on the Atlantic coastal plain of the United States. The tube of the genotype, *H. onyx*, was described as having "six elevated, angular, longitudinal ribs extending from base to apex."

Morton compared *Hamulus* with *Dentalium* and *Serpula*, stating that its tubes differed from the tubes of those genera in their "constant involuted form." He figured two tubes of *H. onyx*. The first (his pl. 2, fig. 8) came from Lynch's Creek, South Carolina. It has probably been lost. The second (his pl. 16, fig. 5) was from "the older Cretaceous deposits at Erie, Alabama"; and he stated that he had also "a small individual from New Jersey." He assigned to his new genus the tubes which Münster had named *Serpula sexsulcata* (see Goldfuss, Petrefacta Germaniae, 1826, p. 238, pl. 70, figs. 13a, b).

In 1859 Gabb [2] described from Cretaceous beds at Prairie Bluff, Alabama, fossils, which he considered to be worm tubes and which he named *Hamulus squamosus*, that differed from the tubes of *H. onyx* "in having a strongly marked raphe" which nearly doubled the width of the tube. He later [3] described as *Hamulus major* another, somewhat larger, tube from the Upper Cretaceous Ripley beds of Eufaula, Alabama.

In 1898 Johnson [4] recorded "*Hamulus squamosus*" from Upper Cretaceous beds in a well at Mount Laurel, New Jersey. His record is believed to be based on four calcareous tubes in the Academy's collection (no. 683).

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[1] Synopsis of the organic remains of the Cretaceous group of the United States, 1834, pp. 73-74, pl. 2, fig. 8, pl. 16, fig. 5.

[2] Catalogue of the invertebrate fossils of the Cretaceous formations of the United States, 1859, p. 1.

[3] Jour. Acad. Nat. Sci. Phila., 2nd ser., vol. 4, 1860, p. 399, pl. 68, fig. 46.

[4] Proc. Acad. Nat. Sci. Phila. for 1898, pp. 461-464. See also Woolman, Ann. Rept. State Geologist New Jersey for 1897, (1898), p. 265.

These tubes were incorrectly identified as *H. squamosus*, and are probably referable to *Hamulus falcatus*, a species which is discussed on a later page of the present paper. The beds from which they came were said by Woolman to lie in the Merchantville Formation.

In 1916 Gardner [5] recorded *Hamulus onyx* from the Upper Cretaceous Matawan Formation at Ulmsted Point, Anne Arundel County, Maryland, and the Upper Cretaceous Monmouth Formation one mile west of Friendly, Prince George's County, in the same state, and expressed the opinion that *H. squamosus* was probably only a young stage of *H. onyx*.

Five years later Wade [6] discussed the genus *Hamulus* and the species *H. onyx* and *H. squamosus*, which he believed to be specifically distinct because he found that tubes of *squamosus* averaged larger in size than those of *onyx*. He noted that *squamosus* was found in deposits which indicated that it had lived on muddy bottoms (a conclusion which is supported by the flanges on its tube, which would have prevented the tube from sinking into a soft mud), and reported the discovery of tubes of *onyx* possessing opercula which proved that *Hamulus* was a genus of operculate Serpulid worms. Wade recorded *onyx* from the Upper Cretaceous Monmouth Formation of Maryland, the Selma and Ripley formations of Mississippi and Alabama, the Eutaw Formation of Alabama, and the Austin Formation of Texas; but he erroneously gave Erie, Alabama, instead of Lynch's Creek, South Carolina, as the type locality of the species. He also described a new species, *Hamulus angulatus*, from the Upper Cretaceous Ripley Formation of Coon Creek, Tennessee, and called attention to the occurrence of *Hamulus* in the Cretaceous of Europe.

In 1926 Wade [7] noted the presence of *H. onyx, H. angulatus, H. squamosus*, and an unnamed species of *Hamulus* in the Ripley Beds at Coon Creek and figured examples of the four species from that locality, including opercula of *onyx*.

In 1923 Stephenson [8] had discussed the genus *Hamulus* and the species *onyx, major*, and *angulatus*, and had described the new forms *H. squamosus rugosus* and *H. walkerensis* from the Upper Cretaceous Black Creek Formation of North Carolina. He had also recorded *H. onyx* from a number of other Upper Cretaceous formations in the southeastern United States, among them the Peedee Formation of Lynch's Creek, South Carolina, from which Morton's holotype came. And in 1940 he and Monroe [9] figured *onyx* and *squamosus* and reported *H. onyx, H. squamosus*, and *H. major* from the

[5] Maryland Geol. Survey, Upper Cretaceous, 1916, pp. 747-748.

[6] Proc. U. S. Nat. Mus., vol. 59, 1922, pp. 43-46, pls. 9 and 10.

[7] U. S. Geol. Surv., Professional Paper 137, 1926, pp. 30-31, pl. 2, figs. 4-18.

[8] North Carolina Geol. and Economic Surv., vol. 5, 1923, pp. 71-79, pl. 10, figs. 1-11.

[9] Mississippi Geol. Surv., Bull. 40, 1940, p. 149, tables facing pp. 108, 182, 208, 230, and 248, and pl. 14, figs. 4 and 5.

Upper Cretaceous Selma Formation, *H. onyx* and *H. squamosus* from the Upper Cretaceous Coffee, Ripley, and Prairie Bluff formations, and *H. onyx* from the Upper Cretaceous Owl Creek Formation, of a number of localities in Mississippi. *H. onyx* was also reported in 1939 by Rutsch [10] from the Upper Cretaceous of Trinidad.

The tubes on which these species of *Hamulus* are based are all (with the possible exception of the tube of *H. walkerensis*, the lower portion of which is unknown) curved calcareous fossils which taper gradually to a point at the closed lower end and have longitudinal ridges on their outer walls. They have been classified by Gabb as Annelid worms and have been placed by Gardner, Wade, and Stephenson in the Serpulidae. All the tubes have smooth inner walls, and the sediment which has filled many of them after the death of their occupants forms a curved, claw-shaped, compact mass, which is circular in cross section and has a smooth outer surface.

"*Falcula*"

In 1869 Conrad [11] had described as "*Dentalium falcatum*", small, smooth, claw-shaped, tube fillings from Cretaceous beds at Crosswicks, New Jersey, which looked as though they might be the fillings of curved, tapering tubes. He had stated that a similar species, *Dentalium hamatum*, occurred in India. A year later he had decided that his New Jersey fossils were perhaps referable to this Indian species, but that the species was not a *Dentalium*, but deserved a genus of its own, and he had proposed for it the new genus , "*Falcula*" [12]. He doubted whether his new genus belonged in the Dentaliidae; and he referred to the genotype as "*Dentalium hamatus*", erroneously indicating that he had used that name for his New Jersey fossil when he had described it the preceding year. The Upper Cretaceous formation at Crosswicks from which Conrad's fossils had come is now called the Woodbury Clay.

In 1892 Whitfield,[13] convinced that the Indian species, *Dentalium hamatum*, was not conspecific with Conrad's New Jersey fossils, though it might be a *Dentalium*, had used for the New Jersey fossils the name, "*Dentalium (Falcula) falcatum*." Whitfield reported that this species was found in the "Lower Green Marls" (i.e., the Woodbury Clay) at Crosswicks, New Jersey, and possibly elsewhere in the Cretaceous beds of that state.

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[10] Jour. Paleontology, vol. 13, 1939, pp. 521-522 and p. 519, text-figs. 5 and 6.

[11] American Jour. Conchology, vol. 5, 1869, pp. 44-45, pl. 1, figs. 12, 16.

[12] American Jour. Conchology, vol. 6, 1870, p. 77.

[13] Geol. Surv. New Jersey, Gastropoda and Cephalopoda of the Raritan clays and greensand marls of New Jersey, 1892, pp. 168, 169, pl. 20, figs. 12-18 (published also as Monograph 18 of the U S. Geol. Survey).

In 1905 Johnson[14] had come to the conclusion that the fossils for which Conrad had erected the genus *Falcula* were the "internal casts of a *Hamulus*." He thought that Conrad's specimens were probably referable to *Hamulus onyx*, but he nevertheless used for them the name *Hamulus falcatus*.

In 1907 Weller,[15] who knew that Johnson had referred them to *Hamulus*, had discussed these fossils, using for them, as Johnson had done, the name *Hamulus falcatus*, and adding the following comment: "This species is known only from internal casts, and is quite probably not distinct from *H. squamosus* Gabb, an Alabama species described from the shell itself. A single individual from the Marshalltown clay-marl has been observed upon which a portion of the shell is preserved, which shows the same longitudinal folds present in the Alabama specimens." Weller recorded *Hamulus falcatus* from the Marshalltown Clay-marl near Swedesboro, New Jersey, and from the Navesink Marl at "various localities" in that state. The Marshalltown and Navesink formations are of Late Cretaceous age. As there are no specimens of *H. falcatus* in the New Jersey Geological Survey's or in the Academy's collections, that are labeled as having come from the Navesink Formation, while there are specimens of a nearly related species (described in the present paper as *H. wenonahensis*) in the Geological Survey of New Jersey's collection and in the collection of Princeton University, which came from the Upper Cretaceous Wenonah, Marshalltown, and Navesink formations of New Jersey, it seems probable that Weller's record of *H. falcatus* from the Navesink Formation was actually based on specimens of *H. wenonahensis*. The two specimens of *H. falcatus* which Weller figured as from the Navesink Formation were collected at Crosswicks, New Jersey, and are probably actually from the Woodbury Formation.

Weller[16] had also described as "*Hamulus lineatus*" the fillings of straight tubes which he had found in the Upper Cretaceous Merchantville Clay-marl and Navesink Marl of New Jersey, and had figured and discussed a larger, unnamed, straight tube filling, which he referred to as "*Hamulus* ?? sp.", from the Upper Cretaceous Wenonah Sand of that state. But, as is explained on a later page of the present paper, these specimens are probably not referable to *Hamulus*.

"*Falcula*" = *Hamulus*

Thus, we have on the one hand the genus *Hamulus* Morton, 1834, proved to be referable to the operculate Serpulidae, anchored to the genotype,

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[14] Proc. Acad. Nat. Sci. Phila., vol. 57, 1905, p. 5.

[15] Geol. Surv. of New Jersey, Report on the Cretaceous Paleontology of New Jersey, 1907, pp. 309-310, pl. 22, figs. 11 and 12.

[16] Op. cit., pp 310-311.

H. onyx Morton, 1834, from the Upper Cretaceous Peedee Formation of South Carolina, and based on operculate, curved, tapering calcareous tubes that are closed at the rear, pointed, end; and on the other hand we have the genus *Falcula* Conrad, 1870, anchored to the genotype, *Dentalium falcatum* (Conrad), 1869, from the Upper Cretaceous Woodbury Formation of New Jersey, and based on tapering, curved tube fillings that are pointed at the rear end. And, since the tube fillings of *Falcula falcata* are of much the same general size and shape as the cavity within the tube of *Humulus onyx*, we face the probability that we are dealing here with two genera that are based on the same kind of worms, and that "*Falcula*", which was proposed later than "*Hamulus*" as a generic name, is a synonym of *Hamulus*.

That "*Falcula*" was probably based on the filling of the cavity in the calcareous tube of some species of *Hamulus*, probably *Hamulus onyx*, had been recognized in 1905 by Johnson, who had retained for the genotype of *Falcula* the specific name given to it by Conrad, but had called the fossil "*Hamulus falcatus*." Weller, on the other hand, although he had followed Johnson and used the name "*Hamulus falcatus*", had believed that the fossil was probably the filling of the tube of another species of *Hamulus*, *H. squamosus* Gabb. And Weller had also placed in *Hamulus* some straight, or very gently curved, slightly tapering, tube fillings from the Upper Cretaceous Merchantville and Navesink formations of New Jersey which he had named *Hamulus lineatus*. So, although there seemed little reason to doubt that "*Falcula*" was merely *Hamulus* in a different guise and that Conrad's New Jersey species, "*Falcula falcata*", was a *Hamulus*, there was some doubt whether *falcatus*, itself, was a valid species or was merely the filling of the tube of *Hamulus onyx* or *H. squamosus*. And Weller's assignment of his straight tube filling, *lineatus*, to *Hamulus* was very much open to question, since that filling differed so much in form from those of other species of that genus and was not known to have been the fossil of an operculid Serpulid. The discovery in beds containing *falcata* and *lineata* of actual tubes which could be shown to belong to those species was much to be desired.

Weller had stated that he had seen a single specimen of *falcata* with a portion of the tube attached to the filling, itself, which had come from the Marshalltown Formation of New Jersey, and that this tube fragment displayed "longitudinal folds" like those of *Hamulus squamosus*. This specimen of Weller's is probably the fragment in the collection of the Geological Survey of New Jersey which is numbered 9767. There is another similar, unnumbered, specimen from the same formation and locality, in the same collection. No other author had reported the finding of any more complete specimens which would help paleontologists to determine with certainty just what kind of a tube *falcata* actually had. Until such specimens were

discovered there would necessarily be some uncertainty as to whether all the tube fillings of this kind found in New Jersey were those of tubes which were alike on the outside, as well as on the inside, for tubes which differed from each other in external form might be exactly alike internally.

There have, indeed, been the following two reasons why paleontologists should have doubted whether all fossils of the shape of *falcata* actually belonged to a single species: (1) that the specimens of these claw-shaped fossils that have been found in New Jersey vary in size and in the rate of their tapering, and (2) that, although the interiors of the tubes of *Hamulus onyx, H. squamosus*, and other species of *Hamulus* found in the Upper Cretaceous deposits of the eastern United States are almost identical in form, the exteriors of the various species do differ in the form of their ornamentation. It has seemed probable that tubes of such worms which differ markedly from each other in size and in rate of tapering do really belong to different species. And it must even be assumed as possible that tube fillings of this kind which were alike in all respects might nevertheless be referable to two species of the same size, such as *H. onyx* and *H. squamosus*, which had different external ornamentation. The fillings of the tubes of *H. onyx* and *H. squamosus* would undoubtedly look alike after the removal of the calcareous tubes, although the external ornamentation of the tubes of the two species is different, *onyx* having six longitudinal ridges, all of the same size, and *squamosus* having two of the six ridges with which its tube is adorned (the two being on opposite sides of the tube) so much more prominent than the other four that they are flange-shaped.

The paleontologist might suspect that examples of *falcata* found in deposits which had been muds or clays during the life of the worm were the fillings of the tubes of *squamosus*, for Wade had noted that *squamosus* was almost entirely restricted to clay and chalk beds; but he could not confirm his suspicions unless he found in his clays and chalks fragments, at least, of the tubes by which he could identify the species. Probably the flanges on the tubes of *squamosus* prevented the worms of that species from sinking into the soft mud on which they lived (as the tubes of *onyx* probably would have sunk) and perhaps the examples of *falcata* found in the Woodbury and Merchantville clays were the fillings of the tubes of the general *squamosus* type, while the similar, but less curved, fillings present in the Wenonah Sand were the fillings of tubes resembling those of *onyx;* but these possibilities could be satisfactorily tested only by the discovery of specimens retaining at least some part of the calcareous tubes, themselves.

It has therefore been unfortunate that, although examples of *falcata* are common in some of the New Jersey formations, specimens retaining any portion of the tube have very seldom been found in that state. Up to the present time the only such specimen that appears to have been reported

under that specific name has been the one mentioned by Weller, about which little was known, since Weller did not figure it. Therefore the recent discovery in the paleontological collection of the Academy of Natural Sciences of Philadelphia of other specimens from New Jersey which retain most of the calcareous tube is of importance. These specimens are described and figured in this paper.

Fossils which have been identified by various paleontologists as *Hamulus falcatus* or "*Falcula falcata*" have been collected from a number of localities in New Jersey and deposited in the museum of the Academy of Natural Sciences and in the collections of the Geological Survey of New Jersey and of Princeton University. Unfortunately few of them bear on their labels exact information concerning the formations from which they were secured. It is possible to determine from their locality records that they all came from Upper Cretaceous formations; but there are so many Upper Cretaceous formations in New Jersey, so many of them outcrop only in a single small area, and some of them are so similar to each other in lithology and in the state of preservation of their fossils, that one cannot determine from the fossil and matrix alone from just which formation any particular specimen was obtained. The writer has visited all of the localities from which these fossils came and has attempted to learn which of the formations outcropping at each locality contain examples of *falcatus* and from which of the formations at each place the specimens in the collections of the Academy, the Geological Survey of New Jersey, and Princeton University were secured. He found the species only in the Merchantville and Woodbury formations, and he believes that all the specimens in the collections referred to above came from those two formations.

The discovery that these tube fillings are present in the Merchantville Formation makes the record of "*Hamulus squamosus*" from that formation at Mount Laurel, New Jersey, published by Johnson and by Woolman, which is based on fragments of the tubes, themselves, that are now in the Academy's collection, of special interest because of the information which it gives us about the nature of the tubes in which the Merchantville fillings were formed. These Mount Laurel fossils are fragments of tubes which, although too incomplete for certain specific identification, are similar to the tubes of *Hamulus onyx* and are probably referable to a related species. The probability that they are closely related to *H. onyx* is increased by the fact that they are accompanied by a typical "Ripley" fauna, such as is found associated with that species in South Carolina. And, as the fillings of the tubes of the Mount Laurel fossils are of exactly the same shape and size as the claw-shaped fossils on which Conrad based "*Falcula falcata*", there can be little doubt that *Falcula falcata* (Conrad) is merely the filling of the tube of a *Hamulus* closely related to *H. onyx* Morton. Thus, on the

evidence of these fossils from the Mount Laurel well we may be reasonably certain that a *Hamulus* not greatly different from the South Carolina species, *H. onyx*, occurs in the Merchantville Formation of New Jersey. But this New Jersey species was larger than *H. onyx* and was thus a distinct species, to which the name, *Hamulus falcatus*, should be applied.

The Merchantville Formation is a clay; but the *Humulus* tubes from the well at Mount Laurel do not show any extension of any of their ribs such as is exhibited by the tubes of *Hamulus squamosus*. It is therefore possible that *H. squamosus* did not range as far north as New Jersey.

The Woodbury Formation, which overlies the Merchantville Clay, is also a clay. It was from an exposure of the Woodbury Clay at Crosswicks, New Jersey, that the tube fillings on which Conrad based his species, "*Falculata falcata*", were collected. The numerous specimens from that locality indicate that more or less curved and tapering tube fillings of various sizes must be common in some of the beds of the Woodbury Formation at Crosswicks, although those beds seem not to be well exposed at the present time. Some of these fillings in the Academy's collection are small and claw-shaped, agreeing exactly with the type specimens of "*Falcula falcata*." These small fillings closely resemble in shape and size fillings of the tubes of *Hamulus onyx*. Others are much larger than the types of "*falcata*." But there are some which are intermediate between these large ones and the smaller types, and all, both large and small, are probably referable to the single species, *H. falcatus*. Whitfield believed that all of these New Jersey tube fillings, large and small, were "*falcata*", and he was probably right. And, if they are all referable to a single species, "*falcata*", that species must have grown much larger in New Jersey than *H. onyx* ever grew, for no examples of *H. onyx* whose tube fillings would have been much larger than the relatively small type specimens of "*falcata*" have been reported from the Carolinas or elsewhere where *onyx* has been found.

It is true that two larger, curved, forms of *Hamulus*, *H. major* and *H. squamosus rugosus*, have been recorded by Stephenson[17] from Upper Cretaceous formations of the *Exogyra ponderosa* Zone in North Carolina and Alabama, and their tubes are big enough so that the large tube fillings found at Crosswicks would fit into them. But the paleontologist would be forced to divide the fillings of intermediate size found at Crosswicks arbitrarily between "*falcata*" and the larger species if he recognized two species among them, for there is no hiatus in the graduated series of sizes of such fossils which can be secured from that locality. And, after he had separated out all the large fillings, he could not be certain whether he should assign them

[17] The Cretaceous formations of North Carolina, pt. 1, Invertebrate fossils of the Upper Cretaceous formations. North Carolina Geol. and Economic Surv., 1923, pp. 71-74, pl. 10, figs. 1-7.

to *H. major* or to *H. squamosus rugosus*, for no large tubes of this kind have ever been found in any formation in New Jersey. Therefore, although *H. squamosus rugosus* is not as large as *H. major*, and although most of the larger tube fillings found at Crosswicks are about the same size as the cavity in the tube of *squamosus rugosus* so that they may possibly be referable to that subspecies, and although a few of the largest of the fillings are too big to be referable even to *squamosus rugosus* and thus may possibly be assignable to *H. major*, it is more probable that all of these larger New Jersey fossils are merely the fillings of the tubes of large individuals of *H. falcatus* and that no other species is represented. *H. major* has a somewhat more sharply curved tube than does *H. squamosus rugosus*, the curvature of the tube of *major* being about the same as that of *H. onyx* and *H. squamosus*. The " largest " tube fillings at Crosswicks are more sharply curved than the " large " ones, and it is possible that the " large " fillings are referable to *H. squamosus rugosus* and the " largest " ones are assignable to *H. major;* but there is much variation in the amount of curvature in these New Jersey fossils, and it is more probable that they are all *H. falcatus*. The tubes which they filled were less curved in their older parts than in their younger portions, but even the smaller ones are less curved than are the tubes of *H. onyx*.

Tube fillings that are possibly referable to *H. squamosus rugosus* or *H. major* have also been collected from the Merchantville Formation at Lenola (now Maple Shade), New Jersey; but they, too, are more probably all referable to *H. falcatus*.

Another newly discovered Academy specimen in which the tube is largely preserved came from the Woodbury Formation of New Jersey (exact locality unknown). It is believed to be referable to *H. falcatus*. It resembles *H. onyx* in having six longitudinal ridges, all of equal size, on its outer surface; but it is longer, more slender, and less curved than the tube of *onyx* and has a thinner wall. The cavity within it has about the same diameter as that within the tube of *H. onyx* so that the filling of the New Jersey tube has the same diameter as an example of *H. falcatus*. The filling tapers less rapidly and is less sharply curved than are most specimens of *H. falcatus;* but the tube is nevertheless probably assignable to that species.

Other species of " *Hamulus* "

Weller[18] described and figured from the Cretaceous of New Jersey two straight tube fillings. One of these he referred to *Hamulus* and named *Hamulus lineatus;* the other he assigned tentatively to *Hamulus* without giving it any specific name.

[18] Op. cit., pp. 310-311, pl. 19, figs. 3, 4, 7.

Weller's *Hamulus lineatus* was a long, thin, cylindrical, very slightly tapering, tube filling, which he found in the Merchantville Formation of Lenola (now Maple Shade) and the Navesink Formation of Crawford's Corner. The species was later referred to *Serpula* by Stephenson,[19] who had found it in the Upper Cretaceous Black Creek Formation of North Carolina, the Eutaw Formation of Georgia, and the Ripley Formation of Georgia and Mississippi. Tube fillings which are probably assignable to this species have been found in the Woodbury Formation at Crosswicks, New Jersey. The writer knows of no examples of this species from New Jersey that have any of the tube preserved, but Stephenson figured tubes from the Snow Hill Member of the Black Creek Formation of North Carolina. On a later page of the present paper this species is made the genotype of a new genus.

The single fragment of a large tube filling which Weller described and figured as "*Hamulus*?? sp." was collected from the Wenonah Formation at Crawford's Corner, New Jersey. It so much resembles fossils from the Black Creek Formation of North Carolina figured by Stephenson [20] and identified by him as *Serpula cretacea* (Conrad) that it seems certain that it is congeneric with them. *Serpula cretacea,* which was originally described by Conrad from Snow Hill, North Carolina, as *Diploconcha cretacea,* the genotype of its genus, was later doubtfully identified by Whitfield [21] (as "*Serpula* (*Diploconcha*) *cretacea*") from the Upper Cretaceous "Lower Marl Beds" (probably the Navesink Formation) on Crosswicks Creek, New Jersey. Stephenson [22] considered that Whitfield's specimens were probably correctly identified as *S. cretacea.* But Weller's "*Hamulus*?? sp." and two very similar specimens from the Snow Hill Member of the Black Creek Formation of North Carolina that were figured by Stephenson (op. cit., pl. 9, figs. 8 and 9) and were referred by him "questionably" to *Serpula cretacea,* seem to the writer to be so different from *cretacea* that they must belong to a different species. They are all external impressions of mere segments of tubes, but their diameters are twice those of the tube of *cretacea* and their horizontal ribs are much more prominent and are spaced much farther apart than are the ribs of that species. Weller's specimen of this big species and one of Stephenson's (his fig. 9) retain the fillings of their tubes. These fillings prove that the tubes were thick and that their inner surfaces were smooth.

These large tubes of doubtful generic position are described on a later page as belonging in a new species, *Diploconcha harbisonae.* They and *Diploconcha cretacea* are probably not properly placed in *Serpula,* and

[19] Op. cit., pp. 70-71, pl. 9, figs. 13, 14.
[20] Op. cit., pl. 9, figs. 4-9.
[21] Op. cit., pp. 170-171, pl. 20, fig. 25.
[22] Op. cit., p. 69

Conrad's name, *Diploconcha*, is believed to be the proper one to use for the genus to which they belong. Too little is known as yet of all the characters of these tubes to permit of a fuller definition of their genus than was given by Conrad or of the determination of the exact relationship of the species, *harbisonae*, to *cretacea*. Possibly *harbisonae* and *cretacea* are not congeneric, and *cretacea* may actually belong in the genus *Serpula*. But *harbisonae* is so different from the average *Serpula* that it will almost certainly ultimately be proved, when it is better known, to deserve a genus of its own; and, since Stephenson believed that his Black Creek specimens of *harbisonae* were congeneric with *cretacea*, the writer is assigning *harbisonae* to *Diploconcha*.

Stephenson thought that the tube fillings figured by Whitfield in figures 15, 16, and 17 of his plate 20 as specimens of "*Dentalium* (*Falcula*) *falcatum*" were probably actually the fillings of tubes of "*Serpula*" *cretacea* (i. e., of *Diploconcha cretacea*). The writer feels, however, as has been stated on an earlier page, that these specimens of Whitfield's are more probably the fillings of tubes of some large species of *Hamulus*, such as *H. major* or *H. squamosus rugosus*, or, more probably, of large individuals of *Hamulus falcatus*. They are more sharply bowed than are the tubes of *Diploconcha cretacea*, having almost exactly the type of curvature characteristic of the genus *Hamulus*. They also taper somewhat more rapidly than do the tubes of *D. cretacea*, but at just about the same rate as do the tubes of *Hamulus*. While it is not possible to prove their relationships in the absence of the tubes, themselves, it seems highly probable that Whitfield's tube fillings (his pl. 20, figs. 15-17) are assignable to *Hamulus* rather than to *Diploconcha*.

Systematic Descriptions

The fossils known or reported from the Cretaceous formations of New Jersey that have in the past been referred to *Hamulus* and "*Falcula*" are, for the reasons given above, here distributed among a number of genera and species, which are discussed below.

The first of these species to be discussed, *Hamulus onyx*, although it has been reported from the state, has actually probably not been found in New Jersey. However, as it is the genotype of *Hamulus*, it is described and figured here. The species has an added importance because *Hamulus* has a wide geographic distribution, being found in the Cretaceous rocks of the Caribbean region and Europe, as well as of North America. *Serpula sexsulcata* Munster [23] from the Upper Cretaceous of Amberg, in the Palatinate, Germany, and *Dentalium deforme* Lamarck,[24] from the Cretaceous

[23] See Goldfuss, Petrefacta Germaniae vol. 1, 1832, p. 238, pl. 70, fig. 13a, b; also Chenu, Illustrations Conchyliologiques, vol. 1, 1842, pl. 5, figs. 4, 4a.

[24] Animaux sans vertébres, 2nd ed., vol. 5, 1838, p. 592; and Chenu, op. cit., p. 3, pl. 1. figs. 30-32.

of France, are referable to *Hamulus*. *Hamulus crassus* (Deshayes) from Belgium and France is another European species, and one of the figures (fig. 10) of the species from the Lower Tertiary of England which is referred by Solander [25] to *Dentalium elephantinum* Linné, a living form, so closely resembles *Hamulus sexsulcatus* that it may be identical with it, and may therefore also be a *Hamulus*.

H. sexsulcatus and *H. crassus* may possibly be one and the same species, and both are closely related to *H. onyx*. There are in the Academy's collection specimens of *H. crassus* from the Cretaceous of Cypliès, near Mons, Belgium (no. 15781) and of Autrappe (probably in France, no. 15782); but the writer knows *H. sulcatus* only from possibly inaccurate published figures, and has therefore not been able to determine whether it is identical with *H. crassus*. As some living Serpulidae have very wide geographic distributions it may even be that the comparison of good series of the tubes and opercula of the European forms of *Hamulus* with those of *H. onyx* would prove that all of them were referable to a single species.

Class CHAETOPODA

Order TUBICOLA

Family SERPULIDAE

Hamulus onyx Morton Plate 19, figs. 1-12.

Hamulus onyx Morton, Synopsis of the organic remains of the Cretaceous Group of the United States, 1834, pp. 73-74, pl. 2, fig. 8, pl. 16, fig. 5.

Hamulus onyx Morton, Gabb, Catalogue of the invertebrate fossils of the Cretaceous formations of the United States, 1859, p. 3.

?*Hamulus squamosus* Gabb, Johnson, Proc. Acad. Nat. Sci. Phila., for 1898 pp. 461-464.

Hamulus onyx Morton, Gardner, Maryland Geol. Surv., Upper Cretaceous, 1916, pp. 747, 748.

Hamulus onyx Morton, Wade, Proc. U. S. Nat. Mus., vol. 59, 1922, pp. 43-45, pl. 9, figs. 1, 2, 3, 5, 6.

Hamulus onyx Morton, Wade, U. S. Geol. Surv., Prof. Paper 137, 1926, pp. 30, 31, pl. 2, figs. 4-7, 12.

Hamulus onyx Morton, Stephenson, North Carolina Geological and Economic Surv., vol. 5, 1923, pp. 76-79, pl. 10, fig. 11.

Hamulus onyx Morton, Stephenson and Monroe, Mississippi Geol. Surv., Bull. 40, 1940, p. 149, pl. 14, fig. 5.

Hamulus onyx Morton, Rutsch, Jour. Paleontology, vol. 13, 1939, pp. 521-522 and p. 519, text-figs. 5 and 6.

Wade, who had available a good series of this species, gave the following excellent description of its tube and operculum, the best description of the tube and operculum of a *Hamulus* that has been written:

"Tube small, compact, and rather strong; in form a very elongate, gently curved, ribbed, or corrugated cone; shell of tube made up of two layers—an inner layer of lamellar calcareous material, and an outer layer

[25] In G. Brander, Fossilia Hantoniensia collecta et in Musaeo Britannico deposita, London, 1766, pp. 11-12, pl. 1, figs. 10 and 11.

of chitinous calcareous material bearing the external sculpture; nucleus or protoconch unknown, tube attached to some foreign object during nuclear stage; external sculpture consisting of six prominent axial ribs and sulci; transverse or incremental lines fine and very numerous in some individuals, quite obscure in other individuals; internal surface smooth; aperture circular; apertural margin smooth and sharp; operculum tack-shaped with a three-cornered spick or tooth situated on the edge of the tack head or basal circular plate, anterior surface of basal plate concave marked with a few fine lines radiating from the center and a few irregular concentric lines; posterior side of the basal plate and the sides of the three-cornered tooth or apophyse marked by irregularly ramifying and deeply impressed grooves or sulci which probably represent the seats of muscular or ligamental attachments; posterior extremity of the tooth pointed and tripartate; operculum in place is entirely behind the anterior margin of the aperture, thus forming a water-tight stopper for the tube."

Location of types.—Morton's figured type from Lynch's Creek, South Carolina, appears to have been lost; but his figured specimen from Erie, Alabama, is believed to be in the Academy's collection (no. 2303), and is figured in the present paper. This tube is one of four from Erie which were figured by Stephenson in 1923 as "probably types." It can properly be looked upon as the holotype. The other three (nos. 14996-14998) are probably paratypes. Stephenson states[26] that these specimens are from "the Tombigbee sand member of the Eutaw formation, Erie Bluff, Warrior River, Ala." There are also in the Academy's collection a tube of *H. onyx* (no. 14983) from the Upper Cretaceous Ripley Formation at Coon Creek, McNairy County, Tennessee, and one (no. 2269) from an unrecorded formation and locality in Mississippi. Stephenson (op. cit.) records other specimens from various Upper Cretaceous formations in Georgia, Alabama, Mississippi, Arkansas, and Texas that are preserved in the United States National Museum. The specimen from Coon Creek, Tennessee, is less curved than the other and is referred to *H. onyx* with some hesitation. It has a curvature intermediate between that of *H. onyx* and that of *H. wenonahanus*, a new species which is described on a later page, and it may be a form which is intermediate between those two species. The fauna with which it is associated is a Ripley fauna, and is thus of the same age as the fauna in which the more typical examples of *H. onyx* occur; but the fauna of the Wenonah Formation, of which *H. wenonahanus* is a member, also contains many Ripley species and can not be much younger than the fauna at Coon Creek.

Range.—The species has been reported from the *Exogyra ponderosa* and *Exogyra costata* zones of the Upper Cretaceous of the Atlantic and Gulf coasts of North America and from beds of the same general age in Trinidad. It has been reported from the Matawan and Monmouth beds of Maryland,

[26] Op. cit., p. 77.

the Peedee Formation of South Carolina, the Eutaw and Ripley formations of Georgia, the Eutaw, Selma, and Ripley formations of Alabama, the Ripley Formation of Tennessee, the Brownstown Formation of Arkansas, the Coffee, Ripley, Prairie Bluff, and Owl Creek formations of Mississippi, the Austin, Taylor, and Navarro formations of Texas, the *Exogyra costata* beds of the state of San Louis Potosi, Mexico, and Cretaceous beds in Trinidad. Morton reported it from unidentified Cretaceous formations in New Jersey; but that record can not be verified. Some of the records from other localities may also be based on specimens of *Hamulus falcatus* or *H. wenonahanus*.

Hamulus falcatus (Conrad) Plate 19, figs. 14-28.

Dentalium falcatum Conrad, American Jour. of Conchology, vol. 5, 1869, pp. 44, 45, pl. 1, figs. 12, 16.

Falcula falcata (Conrad), American Jour. of Conchology, vol. 6, 1870, p. 77.

Dentalium (*Falcula*) *falcatum* (Conrad), Whitfield, Gastropoda and Cephalopoda of the Raritan Clays and Greensand Marls of New Jersey, 1892, pp. 168, 169, pl. 20, figs. 12-17 (not fig. 18); United States Geol. Surv., Mon. 18, 1892, pp. 168-169, pl. 20, figs. 12-17 (not fig. 18).

Hamulus squamosus Gabb, Johnson, Proc. Acad. Nat. Sci. Phila. for 1898, pp. 461-464.

Hamulus falcatus (Conrad), Weller, Geol. Surv. New Jersey, Report on the Cretaceous Paleontology of New Jersey, 1907, pp. 309, 310, pl. 22, figs. 11, 12.

Tube curved in a half circle arc in its earlier stages of growth, but becoming gradually less bowed in later stages and almost straight in the latest stage. The curvature of the tube is all in one plane: there is no torsion. The tube expands very gradually and evenly from the pointed initial end to the aperture. It consists of the two layers of calcium carbonate which are characteristic of *Hamulus*, an inner layer, whose inner and outer surfaces are smooth, and an outer layer, whose inner surface is smooth, but whose outer surface bears 6 irregular ridges that increase in size and coarseness from the apex to the aperture and vary in the amount of their development in different individuals. These ridges are unevenly developed in all cases, but have relatively sharp crests, without distinct knobs, in the younger, smaller, stages of growth and become somewhat knobby and sinuous in the older, larger, stages. They are, in general, equally spaced from each other and run roughly parallel to the long axis of the tube. They vary in height in different individuals and are bluntly, not sharply, peaked in cross section. The largest specimens seen, which are incomplete examples of the fillings of tubes, have a diameter of a little more than $\frac{1}{4}$ of an inch at the aperture and must have measured as much as 2 inches or more along the outside curve of the tube. The tubes differ from each other in the amount of their curvature, but all approach or reach a circular curve in their earlier stages of growth, even though they may become almost straight in their later stages. Therefore, in spite of the variations in size and curvature and in the form of the ridges on the tube exhibited by the fossils of this kind found in the Merchantville and Woodbury formations, they are all believed to belong to the one species, *H. falcatus*.

No example of the operculum, itself, of *Hamulus falcatus* has yet been discovered; but three tube fillings of this species from New Jersey—one

from the Merchantville Formation at Maple Shade, the other two from the Woodbury Formation of Crosswicks—in the Academy's collection (nos. 15267 and 14894 h) and Princeton University's collection (no. 55800) carry impressions of the under side of the operculum. These impressions show that the operculum of *falcatus* was similar in its general form and in the style of the ornamentation of its lower surface to that of the operculum of an unidentified species from the Ripley Formation of Coon Creek, Tennessee figured by Wade (1922, pl. 10, figs. 3-5; 1926, pl. 2, figs. 9-11). The radiating ridges on the under side of the New Jersey opercula are, however, more numerous than are those on the under side of the operculum figured by Wade and are very different from those of the operculum of *H. onyx*, which Wade also figured.

Hamulus falcatus differs from *H. onyx* in having a somewhat longer and slenderer tube, which is less acutely curved in its younger stages and has a thinner wall, in having grown to a larger adult size, and in being a little less acutely curved in its young stages. The ridges on the younger portions of the tube are also somewhat more elevated and sharply peaked than they are in *H. onyx*. The later stages of growth of the tubes of *H. falcatus* were not so sharply curved as were the earlier ones, so that in their curvature the young tubes of this species must have resembled tubes of *H. onyx*, while the adult tubes resembled those of *H. major*. Thus, in the curvature of its tube, *H. falcatus* is intermediate between *H. onyx* and *H. major*. The holotype of *H. major*, which is in the Academy's collection (14831) is, however, somewhat curved in all except its most adult portion. But it is so large that its filling must have been somewhat bigger than the largest fillings of *H. falcatus* tubes that have been found. The known range in size of *H. falcatus* tube fillings is shown in the illustrations in the present paper.

Only five examples of *H. falcatus* from New Jersey are known to the writer in which any part of the tube, itself, is preserved. One of these, an almost complete tube, probably from the Woodbury Formation of New Jersey (exact locality unknown) is in the Academy's collection (no. 14843). The remaining four, also in the Academy's collection (nos. 683 a-d), are those from the Merchantville Formation in the well at Mount Laurel which were referred by Johnson (1898) to *Hamulus squamosus*. All five of the New Jersey tubes fall within the size range of the tube fillings which are here assigned to *Hamulus falcatus*, and they are believed to be referable to that species. The tube from the Woodbury Clay is so well preserved that both the internal and external layers remain. This is true also of two of the tubes from the Merchantville Formation at Mount Laurel. But the external layer, which bears the ridges, has been lost from the other two Mount Laurel tubes and only the smooth internal layer is preserved.

The Academy recently secured a tube (no. 14984) from an Upper Cretaceous bed, said to be in the Ripley Formation, at Pleasant Ridge Lake, 4 miles south of Dumas, Mississippi, and another (no. 15087) from the Upper Cretaceous Coffee Formation at Ratliff, in the same state, which are probably referable to *H. falcatus*. The tube from Pleasant Ridge Lake is small and incomplete, only the anterior half being preserved; but this half so closely resembles the corresponding half of the tube from the Woodbury Formation of New Jersey (A.N.S.P. 14843) that it seems almost certain that the two are conspecific. The specimen from Ratliff, Mississippi, is the anterior portion of a larger tube. The external ridges are coarser and more knobby than they are on the Pleasant Ridge Lake tube, but are very similar to those on the largest tube from Mount Laurel. If the beds at Pleasant Ridge Lake are really in the Ripley Formation they are probably from the lower part of that formation, which is of the same age as the Woodbury Formation of New Jersey. The Coffee Formation is also of the same age as the Woodbury.

When only the tube fillings or the smooth inner layer of the tube are preserved the fossils of *Hamulus falcatus* resemble those of *Hamulus wenonahanus* (described below) and of *Dentalium subarcuatum*, a mollusk which is associated with *H. falcatus* in the Merchantville and Woodbury formations of New Jersey; but the tubes of both of these species are less curved in their earlier stages of growth than are those of *falcatus* and the tubes of *D. subarcuatum* taper even more gently than do those of our worm. When the external surface of the shell of *D. subarcuatum* is well preserved it is seen to bear some 10 or more fine longitudinal ridges, instead of the 6 coarser and higher ridges which adorn the tube of *H. falcatus*. The fillings of the tubes of *Hamulus walkerensis* (discussed below) also somewhat resemble those of *H. falcatus*, but they are larger and they are straight, not curved. The tube fillings of "*Serpula*" *lineata* (Weller), which occur with those of *H. falcatus* in both the Merchantville and the Woodbury formations, are not easily confused with those of the latter species because they are always straight and taper very gradually—much more gradually than do those of *falcatus*.

Location of types.—Two tube fillings in the Academy's collection (nos. 14891 a and 14891 b), which are labeled as "types" and are the originals respectively of figures 12 and 14 of plate 20 of Whitfield's 1892 memoir, appear to have been looked upon by Whitfield as cotypes (Conrad designated no types). Their labels state that they were collected at Crosswicks, the locality from which Conrad described *falcatus*, and one of them (no. 14891 b, Whitfield's figure 14) is so similar to Conrad's 1869 figure 12 that it is probably the specimen from which that figure was made. The writer has been unable to locate the other specimen which Conrad figured (his fig.

16). There are, however, in the Academy's collection 16 other specimens (nos. 14894 a-p) from the Woodbury Formation at Crosswicks which may have been collected by Conrad. One of these (no. 14894 a) is believed to be the original of Whitfield's 1892 plate 20, figure 13. The originals of Whitfield's figures 16 and 17 are also in the Academy's collection (nos. 14895 a and 14895 b); but the writer has not been able to find in that collection the specimen from which Whitfield's figure 15 was made (Whitfield's figure 18 is referred to *Hamulus walkerensis*, which is discussed on a later page). Other specimens (plesiotypes) from New Jersey in the Academy's collection are nos. 14843 (the specimen from an unknown locality in New Jersey, probably from the Woodbury Formation, which has most of the tube preserved), 683 a-d (the specimens from the Merchantville Formation in the well at Mount Laurel recorded by Johnson), and 12794 and 14999 (from the Merchantville Formation at Maple Shade). A plesiotype from the Merchantville Formation at "Lenola" (Maple Shade) is no. 8894 in the collection of the Geological Survey of New Jersey. Other plesiotypes from the Merchantville Formation at Maple Shade are nos. 53628-53631, 53633, 53635, 53637, and 53638 in the Princeton University collection, and plesiotypes from the Woodbury Formation half a mile northwest of Crosswicks are nos. 53642, 53643, 54313, and 55794-55800 in the same collection. A specimen from the Woodbury Formation at Crosswicks which shows the impression of the under side of the operculum is no. 15267 in the Academy's collection. The tube from the Coffee Formation at Ratliff, Mississippi is A.N.S.P. 15087, and that from the Ripley Formation of Pleasant Ridge Lake, in the same state, is A.N.S.P. 14984.

Range.—Upper Cretaceous, Merchantville and Woodbury formations of New Jersey and Coffee and Ripley (probably the lower part only) formations of Mississippi. As has already been noted, Weller recorded the species from the Navesink Formation of New Jersey; but his record was probably based on specimens of *H. wenonahanus*. The writer has seen no example of *H. falcatus* from the Navesink Formation. The specimens from the Merchantville Formation were collected at Maple Shade and from a well at Mount Laurel, and those from the Woodbury Formation came from near Crosswicks—all in New Jersey. The localities of the Mississippi specimens are given in the preceding paragraph.

Discussion.—It is interesting to note that curved cavities, once occupied by tubes which had very much the same shape as the smaller tubes of *Hamulus falcatus*, have been described from the Late Cambrian Skeels Corners Formation of Vermont.[27] These Cambrian fossils are very much older than our Cretaceous ones and never have the tube preserved, so it can not be determined whether the tube was composed of calcite, as it was

[27] Howell, B. F., Bull. Wagner Free Inst. Science, vol. 9, 1934, pp. 112, 113, 1 pl.

in *Hamulus*. Whether the tubes of the Cambrian and the Cretaceous species were composed of the same material or not, it seems certain that the animals inhabiting them must have differed too much to permit of their classification in a single genus. The similarity of the cavities left by the Cambrian tubes to those left by the tubes of *Hamulus falcatus* is so great, however, as to indicate that the Cambrian species was a Serpulid worm and that its genus, *Bovicornellum*, should be placed in the Serpulidae. Small, curved, tapering tubes which may have been occupied by Serpulid worms have also been described from Lower Cambrian rocks in Sweden.[28] These tubes were named by their describer, Moberg, *Dentalium ? cambricum;* but they can hardly be referable to *Dentalium.* They are, however, very similar to the genotype of *Bovicornellum, B. vermontense*, and Moberg's species is here assigned to that genus.

There is no evidence that the outer surface of the tube of *Bovicornellum* bore ridges such as are present on the tubes of *Hamulus*, and it is probable that the tube of *Bovicornellum* was smooth externally. Nevertheless it should be noted that there is no trace of external ridges on any of the New Jersey Cretaceous fossils which have been assigned to any species of *Hamulus* except in those cases where the outer of the two calcareous layers of which the tube was composed is preserved. Most of the New Jersey Cretaceous fossils believed to be referable to *Hamulus* consist of a smooth-walled, tubular, tapering cavity, in which rests loosely a smooth-walled, curved, claw-shaped object that is composed of material that had filled the tube of the worm after the death and removal of the animal. The tube, itself, is in most cases missing, having been dissolved away; but the space between the outer wall of the cavity and the claw-shaped tube filling which lies loose within it indicates that a calcareous tube was once present. The smooth inner wall of the cavity would lead one to suppose that the outer wall of this calcareous tube had likewise been smooth; but certain specimens of *Hamulus falcatus* preserved in the Academy's collection afford evidence that, though the tubes had a smooth inner layer and a ridged outer layer, the ridged outer layer dissolved away easily and usually disappeared completely before the tube was buried so that no trace of its external ornamentation was preserved on the inner surface of the cavity in the matrix which was left when the inner layer had also dissolved. A tube in the Academy's collection (no. 14843) has both the inner and the outer layer preserved, and the outer layer does bear ridges. One of the tubes from the well at Mount Laurel, A.N.S.P. 683a, has both layers preserved, and the outer layer bears ridges. One of the Mount Laurel tubes, A.N.S.P. 683b, lacks most of the outer layer (though the inner layer is well preserved), but retains remnants of it which indicate that it bore ridges. The

[28] Geologiska Föreningens i Stockholm, Förhandlingar, vol. 14, 1892, p. 117, pl. 3. figs. 16 and 17.

other two specimens from Mount Laurel, A.N.S.P. 683 b and c, retain none of the outer layers, but have the smooth-surfaced inner layer well preserved. Such specimens as these last two (b and c) would, had this inner layer been removed by solution, have left cavities and tube fillings of the typical *Hamulus* sort commonly found in the Cretaceous beds of New Jersey.

Wade[29] has stated that the tube of *Hamulus* is "made up of two layers—an inner layer of lamellar calcareous material, and an outer layer of chitinous calcareous material bearing the external sculpture." This outer layer was probably more easily soluble than the inner one because it was in part chitinous, while the inner layer was mainly or entirely composed of calcium carbonate. If Wade's statement is correct and if we have properly interpreted the evidence afforded by the Academy's specimens we may safely assume that, although these specimens show no traces of the ridges which are characteristic of the tubes of *Hamulus*, the curved cavities found in the Cretaceous deposits of New Jersey once held tubes of that genus of worms and that the claw-shaped objects found within the cavities are the fillings of those tubes

If we accept this explanation of the nature of these fossils we are led to assume that certain other fossils of the same kind which have been found in the Upper Cretaceous Wenonah and Marshalltown formations of New Jersey are also referable to *Hamulus*, although they differ specifically from the fossils of *H. falcatus*. Two of these fossils (the only two known from the Marshalltown Formation) are fragments of tubes in which both layers of the shell are preserved. The others (all from the Wenonah Formation) are cavities and tube fillings. As the Wenonah tube fillings are more complete than the others they will be described first. All are assigned to a new species, *H. wenonahanus*.

Hamulus wenonahanus new species Plate 20, figs. 1-3.

Tube fillings similar to those of *H. falcatus* in size and form except that the portion of the filling nearer the apex is less curved. The fillings taper about as they do in *H. falcatus;* and, as is the case with that species, this tapering distinguishes even fragments of the fillings of *H. wenonahanus* from fragments of the tube fillings of "*Hamulus*" *lineatus*, which taper almost imperceptibly.

About a dozen specimens of *H. wenonahanus* have been collected from the Wenonah Formation that consist of tube fillings in place within the cavities in the matrix. In all but one of them the wall of the cavity is smooth, the outer, ridged layer of the tube having been dissolved before the burial of the tube and the matrix having been moulded around the smooth inner layer, which was later also removed by solution. But in one

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[29] Proc. U. S. National Museum, vol. 59, 1922, p. 43.

specimen (Princeton University no. 53771) the mould of the outer layer of the tube is preserved and shows that there were six longitudinal ridges on the outer surface, as in *H. falcatus.* This is corroborated by the two fragments of tubes believed to be referable to *H. wenonahanus* which have been secured from the Marshalltown Formation (New Jersey Geol. Surv. no. 9676), which bear six ridges. In both the Wenonah and the Marshalltown specimens these ridges are much larger and more prominent than are the ridges on the tubes of *H. falcatus.*

Location of types.—The holotype is a nearly complete tube filling, no. 9680 in the collection of the New Jersey Geological Survey. Paratypes are 2 fragmentary tubes (New Jersey Geol. Surv. 9676) and 15 tube fillings (New Jersey Geol. Surv. 9681), 3 of which include the cavities in the matrix; a tube filling with its cavity, in the Academy's collection (no. 14980), and 15 tube fillings, some of which include the cavities, in the Princeton University collection (nos. 53771-53774, 53776-53780, and 55843-55848).

Range.—The holotype is from the Upper Cretaceous Wenonah Formation near Marlborough, New Jersey. One of the paratype fillings in the New Jersey Geological Survey's collection (no. same as the holotype) is from the same formation and locality, the others (N. J. Geol. Surv. no. 9681) are from the Wenonah Formation at Crawfords Corner, New Jersey. The paratype in the Academy's collection (no. 14980) and some of the paratypes in the Princeton collection (nos. 53771-53774 and 53776-53780) are from the Wenonah Formation half a mile east of the Crawfords Corner school house. The two fragmentary paratype tubes in the collection of the Geological Survey of New Jersey (no. 9676) are from the Upper Cretaceous Marshalltown Formation near Swedesboro, New Jersey. The Marshalltown Formation underlies the Wenonah Formation and is probably not much older than the Wenonah. Six tube fillings in the Princeton collection (nos. 55843-55848) are from the Navesink Formation in the bed of a stream a quarter of a mile from the southern of the two roads connecting Mount Holly and Pemberton, New Jersey, near the road running through Birmingham that connects the southern Mount Holly-Pemberton road with the northern road between those two towns. The Navesink Formation overlies the Wenonah Formation and is probably not much younger than the Wenonah.

Discussion. — It seems probable that *Hamulus wenonahanus* is a descendent of *H. falcatus* which differed from *falcatus* in having a less curved tube. *H. wenonahanus* would appear to be a useful index fossil for the Wenonah Formation (and possibly for the Marshalltown and Navesink formations), just as *H. falcatus* is a good index fossil for the Merchantville and Woodbury formations.

Hamulus walkerensis Stephenson Plate 20, fig. 4.

Dentalium (*Falcula*) *falcatum* Conrad, Whitfield, Gastropoda and Cephalopoda of the Raritan Clays and Greensand Marls of New Jersey, 1892, pl. 20, fig. 18.

Hamulus walkerensis Stephenson, North Carolina Geol. and Econ. Surv., vol. 5, 1923, pp. 74, 75, pl. 10, figs. 9 and 10.

One of the tube fillings from New Jersey in the Academy's collection (no. 15085) that was figured by Whitfield and referred by him to "*Dentalium* (*Falcula*) *falcata*" is straight, not curved, and agrees exactly in form and size with the species later described by Stephenson from North Carolina as *Hamulus walkerensis.* The label accompanying this specimen states only that the filling was collected from the Cretaceous of New Jersey; but the fossil probably came from the Woodbury Formation at Crosswicks. The Woodbury Formation is of the same age as the beds of the Black Creek Formation from which Stephenson secured his specimens of *H. walkerensis,* and the New Jersey specimen is believed to be referable to that species and is here assigned to it.

Location of types.—The holotype is U. S. National Museum no. 31468. The New Jersey specimen in the Academy's collection is no. 15085.

Range. — Snow Hill Member of Black Creek Formation, Upper Cretaceous, of North Carolina, and Upper Cretaceous (probably Woodbury Formation) of New Jersey.

Another unnamed species which is probably a Serpulid worm and was tentatively assigned by Weller to *Hamulus* occurs in the Cretaceous of New Jersey. It is believed to be referable to *Diploconcha* and is here described as a new species of that genus.

Diploconcha harbisonae new species Plate 20, figs. 6-8.

Hamulus ? ? sp. Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, 1907, p. 311, pl. 19, figs. 3, 4.

Serpula cretacea (Conrad)?, Stephenson, Cretaceous Formations of North Carolina, pt. I, North Carolina Geol. and Econ. Surv., vol. 5, 1923, pl. 9, figs. 8 and 9.

This species is based entirely on the tube fillings and the moulds of the exterior of the tube, and the structure of the tube can therefore only be inferred. If, as Stephenson believed, the tube was similar in composition to that of *Diploconcha cretacea* Conrad, it was made up of a number of thin layers, arranged as a series of truncated cones which fitted, one within another, so that the wall of the tube was relatively thick. The tube was large and tapered slowly. Those parts of it which we know about from the incomplete fillings available to us were straight or almost straight. The inner surface of the tube was smooth, the outer surface was ornamented with a series of coarse, parallel, encircling ridges. The only part of the tube known is the larger end. As *Diploconcha cretacea* bears similar, though smaller, ridges on the anterior portion of its tube, but only less

prominent ones on the rest of the surface, it is probable that the ridges in *D. harbisonae* were also smaller nearer the apex than toward the aperture.

As noted on an earlier page, Weller assigned his specimens of this species very doubtfully to *Hamulus*. Stephenson placed his in *Serpula* and referred them with some hesitation to "*Serpula*" *cretacea*. The writer believes that they are, because of the greater size of their external encircling ridges, distinct from the species *cretacea*, and that Conrad's genus, *Diploconcha*, in which they possibly belong, is, because of the structure of its tube and the encircling transverse ridges on its outer surface, a valid one and should not be merged with *Serpula*.

Location of types.—The holotype is no. 7677 in the collection of the Geological Survey of New Jersey. Two paratypes are nos. 31457 and 31458 in the U. S. National Museum. An additional specimen, from the Woodbury Formation, which is tentatively assigned to this species, is A.N.S.P. 15425.

Range.—The holotype is from the Wenonah Formation, Upper Cretaceous, at Crawfords Corner, New Jersey. The paratypes are from the Snow Hill Member of the Black Creek Formation, Upper Cretaceous (upper part of *Exogyra ponderosa* Zone) of Whiteley Creek Landing, Neuse River (U. S. National Museum 31458), and of Bryant Newkirk's marl hole, Black River (U. S. National Museum 31457), both in North Carolina. The upper part of the Snow Hill Member of the Black Creek Formation is believed to be of the same age as the Wenonah Formation. The specimen in the Academy's collection which is tentatively assigned to this species (no. 15425) is from the Woodbury Formation near Crosswicks, New Jersey.

Discussion.—When Stephenson[30] discussed *Diploconcha cretacea* he stated that the specimen originally figured by Conrad had been lost, but that another, which was probably a paratype, was no. 31905 in the collection of the U. S. National Museum. Two fragments from the "Ripley Group" of Snow Hill, North Carolina (the type locality of the species) whose label, in Conrad's handwriting, indicates that they are the "types" of this species, are no. 15866 in the Academy's collection. They are much less complete than the specimens originally figured by Conrad,[31] but they may be parts of them and thus be the cotypes of the species. The larger of these specimens is figured in the present paper (pl. 20, fig. 5).

The tube of the genotype of *Diploconcha*, *D. cretacea*, is much smaller than that of *D. harbisonae* and the heavier ridges on the outside are much larger than those of the latter species. The difference in size is so great that one would be led to doubt whether *harbisonae* belonged in *Diploconcha*

[30] Op cit., pp. 67-70, pl. 9, figs. 1-7 and 10-12 (not figs. 8 and 9).

[31] Geol. Survey North Carolina Rept., vol. 1 (by W. C. Kerr), 1875, App. A, p. 12, pl. 2, fig. 26.

were it not for the fact that Stephenson figures tubes, believed by him to be referable to *D. cretacea*, which are intermediate in size between the "type" specimens of *cretacea* and the holotype of *harbisonae*. Even with this evidence, one wonders whether *harbisonae* may not be so different from *cretacea* as to deserve a genus of its own. A final decision on this question should, however, await the discovery of an actual tube of *harbisonae*, which will demonstrate whether the tube of that species has the same structure as that of *D. cretacea*.

The remaining worm tube from the Cretaceous of New Jersey which has been referred in the past to *Hamulus* is the straight one which Weller called *Hamulus lineatus*. Stephenson considered this species to be a *Serpula*, but its straightness argues against its inclusion in a genus whose very name implies a sinuous form, and it is believed to deserve a genus of its own. Such a genus is therefore proposed for it here.

LONGITUBUS new genus

Worms, presumably Serpulidae, with long, straight or almost straight, unornamented, calcareous tubes which are of nearly the same diameter throughout. The tubes sometimes deviate a little from straightness, but never to any great degree. The internal surface of the tube is smooth, the external surface is marked by closely spaced, fine, encircling ridges. The diameter of a large tube varies from less than 2 mm. at the smaller end to as much as 4 mm. at the anterior end. The thickness of the tube wall varies from half a millimeter to one millimeter. The largest tube known to the writer is 82 mm. long and 4 mm. in diameter at the anterior end. No evidence of an operculum has been found. The genotype is *Hamulus lineatus* Weller. No other species is known. The genotype has been reported only from Upper Cretaceous formations of the *Exogyra ponderosa* and *Exogyra costata* zones of New Jersey, North Carolina, Georgia, and Mississippi.

Longitubus lineatus (Weller) Plate 20, figs. 9-21.

Hamulus lineatus Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, 1907, p. 310, pl. 19, fig. 7.

Serpula lineata (Weller), Stephenson, North Carolina Geol. and Econ. Surv., vol. 5, 1923, pp. 70-71, figs. 13 and 14.

Weller, who knew this species only from the moulds of the exterior of the tube and from tube fillings, referred it to *Hamulus*. He stated that, although the occupants of the tubes were probably annelid worms, the tube fillings which he had seen had lain parallel with the bedding of the enclosing sediments, not vertical to it. Stephenson, who found specimens in North Carolina in which some of the calcareous tube was preserved, showing that it resembled in texture and external surface the tube of a *Serpula*, referred the species to that genus. The tube is, however, thicker walled than the tubes of most species of *Serpula*.

In the Academy's collection (no. 91) there is a block of Merchantville Clay from Lenola (now Maple Shade), New Jersey, in which two examples of this species are preserved that lie at right angles to each other; but, since no bedding planes can be seen in the clay, it is not possible to determine whether either of the tubes was vertical to the bedding, or whether both are horizontal to it. As all the tube fillings which Weller found lay parallel with the bedding and the tubes of Serpulid worms commonly extend laterally, unless they were attached to a solid object (which seems not to have been true of the tubes of *L. lineatus*), and are not buried in the bottom sediments during the life of the worm, the tubes of *lineatus*, in spite of their resemblance in form to the perpendicular burrows of certain modern marine worms, probably did not stand upright in the bottom muds, but lay horizontally on the sea floor.

Location of types.—Since Weller, when he described this species, did not designate any types, the tube filling which he figured is here designated as the holotype. It is no. 7754 in the collection of the Geological Survey of New Jersey and is from the Merchantville Formation at Lenola (now Maple Shade), New Jersey. Weller recorded the species also from the Merchantville Formation near Jamesburg, New Jersey, and from the Navesink Formation near Crawfords Corner, in the same state, adding that the species was "found commonly in the Merchantville and Navesink formations." His specimens from the Navesink Formation near Crawfords Corner are no. 9849 in the collection of the Geological Survey of New Jersey and 18645 in the Walker Museum of the University of Chicago; but the specimens on which his record of the species from the Merchantville Formation at Jamesburg was based appear to have been lost. Tophomeotype fillings from the Merchantville Formation at Maple Shade are nos. 28, 91, 12991, and 15682-15684 in the Academy's collection and nos. 53634, 53639-53641, 53644-53646, 53648-53653, 53658, 53668, and 55801-55814 in the collection of Princeton University. Plesiotypes from the Merchantville Formation at Maple Shade are nos. 53654-53657 in the Princeton collection. There are also in the Princeton collection (nos. 4190 and 55849-55857) tube fillings of this species from the Navesink Formation in the bed of a stream a quarter of a mile from the southern of the two roads connecting Mount Holly and Pemberton, New Jersey, near the road running through Birmingham that connects the southern Mount Holly-Pemberton road with the northern road between those two towns. One of these specimens (no. 55849) has a little of the inner portion of the tube preserved. Other fillings in the Princeton collection, from the Navesink Formation in a cut on the New Jersey Central Railroad a mile east of the steamboat dock at Atlantic Highlands, New Jersey, are nos. 53117-53121, and specimens in the same collection, from the Navesink Formation at Birmingham, New Jersey, are

nos. 41740-41742. Plesiotype fillings from the Woodbury Formation half a mile northwest of Crosswicks, New Jersey, are no. 53682 in the Princeton collection. Examples of *Longitubus lineatus* from the Upper Cretaceous Ripley Formation of Coon Creek, Tennessee, in which both the filling and the tube, itself, are preserved, are no. 15865 in the Academy's collection, and similar specimens from the Upper Cretaceous Coffee Sand Member of the Eutaw Formation of Ratliff, Mississippi are no. 15867. An unidentified tube, whose label states that it is from the Pliocene of Biot, France (A. N. S. P. 14863), and which closely resembles the tubes from Coon Creek, may possibly be referable to *Longitubus*, but the writer hesitates to make any further statement about this tube until he can verify the presence of such a form at Biot and the age of the beds at that locality. Somewhat similar tubes, presumably from the Lower Tertiary of England (although their locality is not given on their labels), which are labeled as *Serpula extensa,* are A.N.S.P. 15859 and 15860. *Serpula extensa* was described by Solander[32] from the Lower Tertiary (Eocene or Oligocene) of Hampshire as a species whose tube was not always straight throughout its entire length, and the tube which Solander figured and one of those in the Academy's collection are curved at one end; so *extensa* is probably a *Serpula*, rather than a *Longitubus,* although three of the four tubes of the species in the Academy's collection are straight throughout.

Range. — Upper Cretaceous, Merchantville, Woodbury, and Navesink formations of New Jersey; Snow Hill Member of the Black Creek Formation of North Carolina; Tombigbee Member of the Eutaw Formation, and upper part of the Ripley Formation, of Georgia; and Ripley Formation of Mississippi. The species has not yet been found in any of the formations which lie stratigraphically between the Woodbury and the Navesink, but it will probably ultimately be discovered in at least one of them, the Marshalltown, which somewhat resembles lithologically the Merchantville and Woodbury.

Value of *Hamulus, Diploconcha,* and *Longitubus* as Index Genera in New Jersey

A review of the stratigraphic ranges in New Jersey of the species discussed above reveals that *Hamulus falcatus* has been found only in the Merchantville and Woodbury formations, that *Hamulus wenonahanus* has been collected only from the Marshalltown, Wenonah, and Navesink formations (all of which are younger than the Merchantville and Woodbury), that *Hamulus walkerensis* is probably limited to the Woodbury Formation, that *Diploconcha harbisonae* is known only from the Wenonah Formation,

[32] Op. cit., p. 12, pl. 1, fig. 12.

and that *Longitubus lineatus* ranges from the Merchantville up through the Woodbury and then appears again in the Navesink, although it has not yet been found in any of the intervening formations. The evidence now at hand indicates that *Hamulus falcatus* can be used as an index fossil for the Merchantville and Woodbury formations and that *Hamulus wenonahanus* is a dependable indicator for the younger Marshalltown, Wenonah, and Navesink formations. As these fossils are easily identified and are among the commonest organic remains found in three of these five formations—the Merchantville, Woodbury, and Wenonah—they should prove to be useful in identifying outcrops of at least those three stratigraphic units. These species and the others described above are also useful in correlating the Upper Cretaceous faunas of New Jersey with marine faunas of the same age in other states to the south and southwest.

EXPLANATION OF PLATES 19 AND 20

PLATE 19.

FIG. 1.—*Hamulus onyx* Morton, (Holotype), Eutaw Formation, Erie Bluff, Warrior River, Alabama. A.N.S.P. 2303. (× 2.)
FIG. 2.—Aperture of tube shown in fig. 1. (× 2.)
FIG. 3.—*Hamulus onyx* Morton, (Paratype), Eutaw Formation, Erie Bluff, Warrior River, Alabama. A.N.S.P. 14996. (× 2.)
FIG. 4.—Aperture of tube shown in fig. 3. (× 2.)
FIG. 5.—*Hamulus onyx* Morton, (Paratype), Eutaw Formation, Erie Bluff, Warrior River, Alabama. A.N.S.P. 14997. (× 2.)
FIG. 6.—Aperture of tube shown in fig. 5. (× 2.)
FIG. 7.—*Hamulus onyx* Morton, (Paratype), Eutaw Formation, Erie Bluff, Warrior River, Alabama. A.N.S.P. 14998. (× 2.)
FIG. 8.—Aperture of tube shown in fig. 7. (× 2.)
FIG. 9.—*Hamulus onyx* Morton. Cretaceous, Mississippi. A.N.S.P. 2269. (× 2.)
FIG. 10.—Aperture of tube shown in fig. 9. (× 2.)
FIG. 11.—*Hamulus onyx* Morton, Ripley Formation, Coon Creek, McNairy County, Tennessee. A.N.S.P. 14983. (× 2.)
FIG. 12.—Aperture of tube shown in fig. 11. (× 2.)
FIG. 13.—*Hamulus squamosus* Gabb, (Homeotype), Cretaceous, Prairie Bluff, Alabama. A.N.S.P. 2268 a. (× 2.)
FIG. 14.—*Hamulus falcatus* (Conrad), (Cotype), Woodbury Formation, Crosswicks, New Jersey. A.N.S.P. 14891 a. (× 2.)
FIG. 15.—*Hamulus falcatus* (Conrad), (Cotype), Woodbury Formation, Crosswicks, New Jersey. A.N.S.P. 14891 b. (× 2.)
FIG. 16.—*Hamulus falcatus* (Conrad), Woodbury Formation, Crosswicks, New Jersey. A.N.S.P. 14894 b. (× 1.)
FIG 17.—*Hamulus falcatus* (Conrad), Merchantville Formation, Maple Shade, New Jersey. A.N.S.P. 12794 a. (× 1.)
FIG. 18.—*Hamulus falcatus* (Conrad), Merchantville Formation, Maple Shade, New Jersey. A.N.S.P. 12794 b. (× 1.)
FIG. 19.—*Hamulus falcatus* (Conrad), Woodbury Formation, Crosswicks, New Jersey. A.N.S.P. 14895 a. (× 1.)

FIG. 20.—*Hamulus falcatus* (Conrad), Woodbury Formation, Crosswicks, New Jersey. A.N.S.P. 14895 c. (× 1.)

FIG. 21.—*Hamulus falcatus* (Conrad), impression of lower side of operculum, Woodbury Formation, Crosswicks, New Jersey. A.N.S.P. 15267. (× 2.)

FIG. 22.—*Hamulus falcatus* (Conrad), Woodbury ? Formation, New Jersey. A. N. S. P. 14843. (× 2.)

FIG. 23.—*Hamulus falcatus* (Conrad), Woodbury Formation, Mount Laurel, New Jersey. A.N.S.P. 683 a. (× 2.)

FIG. 24.—*Hamulus falcatus* (Conrad), Woodbury Formation, Mount Laurel, New Jersey. A.N.S.P. 683 b. (× 2.)

FIG. 25.—*Hamulus falcatus* (Conrad), Woodbury Formation, Mount Laurel, New Jersey. A.N.S.P. 683 c. (× 2.) Only the inner layer of the tube is preserved.

FIG. 26.—*Hamulus falcatus* (Conrad), Woodbury Formation, Mount Laurel, New Jersey. A.N.S.P. 683 d. (× 2.) Only the inner layer of the tube is preserved.

FIG. 27.—*Hamulus falcatus* (Conrad), Coffee Formation, Ratliff, Mississippi. A. N. S.P. 15087. (× 2.)

FIG. 28.—*Hamulus falcatus* (Conrad), Ripley Formation, Pleasant Ridge Lake, Mississippi. A.N.S.P. 15984. (× 2.)

FIG. 29.—*Hamulus crassus* (Deshayes), Cretaceous, Cypliès, Belgium. A.N.S.P. 15781. (× 2.)

FIG. 30.—*Hamulus major* Gabb, (Holotype), Cretaceous, Eufaula, Alabama. A.N.S.P. 14831. (× 1.)

FIG. 31.—*Hamulus major* Gabb, Coffee Formation, Tupelo, Mississippi. A.N.S.P. 15088 a. (× 1.)

FIG. 32.—*Hamulus major* Gabb, Cretaceous, Mississippi. A.N.S.P. 15869. (× 1.)

PLATE 20.

FIG. 1.—*Hamulus wenonahanus* new species, (Holotype), filling of tube, Wenonah Formation, Marlborough, New Jersey. N. J. Geol. Surv. 9680 a. (× 2.)

FIG. 2.—Same specimen as figure 1, to show curvature. (× 2.)

FIG. 3.—*Hamulus wenonahanus* new species, (Paratype), part of tube, Marshalltown Formation, Swedesboro, New Jersey. N. J. Geol. Surv. 9676 a. (× 2.)

FIG. 4.—*Hamulus walkerensis* Stephenson, tube filling, Woodbury Formation, Crosswicks, New Jersey. A.N.S.P. 15085. (× 1.)

FIG. 5.—*Diploconcha cretacea* Conrad, (Cotype?), tube, Ripley Formation, Snow Hill, North Carolina. A.N.S.P. 15866 a. (× 2.)

FIG. 6.—*Diploconcha harbisonae* new species, (Holotype), impression of outside of tube, Wenonah Formation, Crawfords Corner, New Jersey. N. J. Geol. Surv. 7677. (× 2.)

FIG. 7.—Same specimen as fig. 6, filling of tube. (× 2.)

FIG. 8.—*Diploconcha harbisonae* new species?, filling of tube, Woodbury Formation, Crosswicks, New Jersey. A.N.S.P. 15425. (× 1.)

FIG. 9.—*Longitubus lineatus* (Weller), (Holotype), filling of tube, Merchantville Formation, Maple Shade, New Jersey. N. J. Geol. Surv. 7754. (× 1.)

FIG. 10.—*Longitubus lineatus* (Weller), filling of tube, Merchantville Formation, Maple Shade, New Jersey. A.N.S.P. 15683 d. (× 1.)

FIG. 11.—*Longitubus lineatus* (Weller), filling of tube, Merchantville Formation, Maple Shade, New Jersey. A.N.S.P. 15683 b. (× 1.)

FIG. 12.—*Longitubus lineatus* (Weller), filling of tube, Merchantville Formation, Maple Shade, New Jersey. A.N.S.P. 15683 c. (× 1.)

FIG. 13.—*Longitubus lineatus* (Weller), filling of tube, Merchantville Formation, Maple Shade, New Jersey. A.N.S.P. 15683 a. (× 1.)

FIG. 14.—*Longitubus lineatus* (Weller), filling of tube, Merchantville Formation, Maple Shade, New Jersey. A.N.S.P. 91. (× 1.)

FIG. 15.—*Longitubus lineatus* (Weller), tube, Coffee Formation, Ratliff, Mississippi. A.N.S.P. 15857 a. (× 2.)

FIG. 16.—*Longitubus lineatus* (Weller), tube, Coffee Formation, Ratliff, Mississippi. A.N.S.P. 15867 c. (× 2.)

FIG. 17.—*Longitubus lineatus* (Weller), end view of tube, Coffee Formation, Ratliff, Mississippi. A.N.S.P. 15867 b. (× 2.)

FIG. 18.—Same tube as fig. 17, side view. (× 2.)

FIG. 19.—*Longitubus lineatus* (Weller), tube showing part of filling, Ripley Formation, Coon Creek, McNairy County, Tennessee. A.N.S.P. 15865 a. (× 2.)

FIG. 20.—*Longitubus lineatus* (Weller), end view of tube, Ripley Formation, Coon Creek, McNairy County, Tennessee. A.N.S.P. 15685 b. (× 2.)

FIG. 21.—Same tube as fig. 20, side view. (× 2.)

FIG. 22.—*Serpula extensa* Solander, end view of tube, Lower Tertiary?, England? A.N.S.P. 15860. (× 2.)

FIG. 23.—Same tube as fig. 22, side view. (× 2.)

HOWELL: HAMULUS, "FALCULA", AND OTHER CRETACEOUS TUBICOLA OF NEW JERSEY

HOWELL: HAMULUS, "FALCULA", AND OTHER CRETACEOUS TUBICOLA OF NEW JERSEY

THE BIRDS OF BOLIVIA. PART II.

by James Bond and Rodolphe Meyer de Schauensee
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The concluding Part of our report on the avifauna of Bolivia covers all the orders of birds known from this republic, excepting the Passeriformes, which are included in Part 1.*

Most of the South American water birds are wide ranging and presumably are found in suitable localities in Bolivia. But the ranges of a number of species are not explicitly known. For example, the range of the grebe *Aechmiophorus major* is given as northern Peru and Amazonia south to the Strait of Magellan. Thus Bolivia should be included in its range, but we find no record of its occurrence in this republic! There can be no doubt, therefore, that the number of Bolivian water birds will be considerably augmented and we trust that future collectors will make an effort to obtain more specimens while engaged in field work in this country.

Our treatment of most of the non-Passerine birds has been conservative. Doubtless some of the forms which we regard as species, will eventually be reduced to subspecific rank. We feel this to be particularly true in regard to the hummingbirds.

Altogether we have recorded 1153 kinds of birds from Bolivia. This number will unquestionably be greatly increased when collections from extreme eastern, and from the tropical zone of northern Bolivia are studied. It is doubtful, however, that many more will be discovered in the western, mountainous areas of this republic. Of the 1153 species and subspecies (including *Tanagra chlorotica taczanowskii* (Sclater), recently recorded from the Rio Mamoré) known to inhabit Bolivia, Mr. Carriker obtained more than 80 per cent. He deserves unstinted praise for his magnificent work, for not only did he assemble superb series of beautifully prepared skins of most of the species, but he also was most successful in ferreting out the rarities. Furthermore, he secured as many as 45 birds new to science.

The Academy owes an immense debt of gratitude to the American Philosophical Society and to Mr. Charles M. B. Cadwalader, President of the Academy of Natural Sciences of Philadelphia, without whose financial support it would have been impossible to have made the Bolivian collection.

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* These Proceedings, 94, 1942, pp. 307-391.

ANNOTATED LIST

Order RHEIFORMES

Family **RHEIDAE** (Rheas)

Rhea americana albescens Lynch Arribalzaga and Holmberg

Recorded from the Bolivian Chaco.

Pterocnemia pennata garleppi Chubb

♂, ♀ (juv.); Cerdas.

Order TINAMIFORMES

Family **TINAMIDAE** (Tinamous)

Tinamus tao weddelli Bonaparte

♂, ♀; Palmar.

The validity of this race was considered doubtful by Peters (Birds of the World, 1, p. 12) and by Todd (Ann. Carnegie Mus., 29, 1942, p. 3), but on comparison with a male and a female of *kleei* from La Pampa, Sandia, Peru, our birds are very much larger. Our Bolivian male measures as follows: wing 270, bill (exposed culmen) 36, tarsus 86; the female, wing 268, bill 36, tarsus 87 mm. The male from Sandia has a wing of 244, bill 31.5, tarsus 69; the female a wing of 230, bill 30, tarsus 64 mm. In coloration Bolivian and Peruvian birds are similar.

The type locality of *kleei* is Chanchamayo, Junín, Peru, and although our birds from Peru were collected farther south we take them to represent typical *kleei*. They certainly differ from Bolivian specimens. Tschudi said that *kleei* was 15 inches in total length (Cat. Bds. Brit. Mus., 27, p. 498) and our two specimens of *kleei* measure approximately 15 inches (♂ 15.5, ♀ 15.1 in.). The two skins of *weddelli*, made up in precisely the same manner by the same collector, measure ♂ 19.9, ♀ 20.6 inches in length.

Tinamus major peruvianus Bonaparte

♂, 2 ♀; Santa Ana, Chiñiri, Todos Santos.

The female from Todos Santos differs from the others in being grayer, less buffy below. Above it is darker and less olivaceous, particularly on the upper mantle. The feathers of the crown, instead of being uniform rufescent, are tipped with black.

Tinamus guttatus Pelzeln

Recorded from the falls of the Rio Madeira.

Nothocercus nigrocapillus nigrocapillus (G. R. Gray)

♂, ♀; Hichuloma, Sandillani.

Crypturellus cinereus cinereus (Gmelin)

Crypturellus cinereus cinerascens Carriker, Proc. Acad. Nat. Sci. Phila., 87, 1935, p. 315 (Chatarona, Dept. Beni, Bolivia).

2 ♂; Chatarona, Chiñiri.

Hellmayr and Conover (Cat. Bds. Amer., pt. 1, no. 1, 1942, pp. 30-31) have examined over 70 specimens of this tinamou and consider that no races are recognizable other than *berlepschi* of the Colombian-Pacific fauna.

Crypturellus obsoletus crucis Bond and de Schauensee

Not. Naturae, no. 93, 1941, p. 1 (Samaipata, Santa Cruz, Bolivia).

3 ♂, 4 ♀; Calabatea, Sandillani, Yungas of Cochabamba, San Jacinto, Samaipata.

Mr. Todd has kindly forwarded his series of this species from Santa Cruz and Cochabamba. Our wing measurements do not agree with his (Ann. Carnegie Mus., 29, art. 1, 1942, p. 10). When describing *crucis* the wing measurements given by us were made by flattening the wing against the ruler and we naturally measured our topotypes of *punensis* in the same manner. Mr. Todd obviously does not take the maximum measurement.

The wings of our specimens of *punensis* (measured flat against the ruler) are ♂ 146.5, ♀ 146.5, 151.5 mm. Below we give our wing measurements (in millimeters) of the Carnegie Museum series of *crucis* as well as those of Mr. Todd, the latter in parentheses.

No. 79409, 163 (154); no. 85274, 162 (158); no. 85284, 162 (159); no. 85584, 155 (144); no. 85641, 163 (157); no. 85676, 162 (151); no. 119582, 159 (154); no. 120420, 155 (149). The wing measurements of our series from La Paz, Cochabamba, and Santa Cruz range from 155 to 168 mm.

With the larger series at hand, the color differences pointed out in the original description do not hold, but *crucis* is easily distinguishable from *punensis* by its constantly larger size.

Crypturellus soui inconspicuus Carriker

Proc. Acad. Nat. Sci. Phila., 87, 1935, p. 315 (Susi, Rio Beni, Bolivia).

2 ♂, 4 ♀; Susi, Santa Ana, Teoponte, Chiñiri.

Crypturellus undulatus undulatus (Temminck)

4 ♂, ♀; Susi, Chatarona, mouth of the Rio Chapare.

A female taken September 15 at Susi was laying. Four eggs, taken September 29 at Chatarona, are gray, only moderately glossy. They measure 51.9x41.4, 51.2x42.4, 51.2x41.8, 44.6x38.8 mm.

Crypturellus noctivagus garleppi (von Berlepsch)

5 ♂; Todos Santos, Chiñiri.

All specimens taken were in breeding condition (Aug. 2-Sept. 8). The soft parts of this rare tinamou are noted as "iris brown; upper mandible black, lower mandible flesh or brownish flesh; feet and tarsi salmon-pink to pink-scarlet."

Crypturellus parvirostris (Wagler)

Recorded from eastern Bolivia.

Crypturellus tataupa tataupa (Temminck)

4 ♂, 4 ♀; Bermejo, Rio Lipeo, Entre Rios, Rio Azero, Villa Montes.

The wings of the males measure 133-140, those of the females 140-148 mm. Bills (exposed culmen) of the males measure 23-24, females 24-26 mm. A male, taken November 22, was in breeding condition.

Crypturellus tataupa peruviana (Cory)

2 ♂, 3 ♀; Santa Ana, Samaipata, Lagunillas.

These birds are markedly smaller than specimens from southern Bolivia and would seem referable to *peruviana*. Wings of males measure 125-131, of females 126-128 mm. The bills of males measure 21.5-22.5, those of females 21-23.5. A male taken November 13 at Lagunillas was in breeding condition. This race has not previously been recorded from Bolivia.

Rhynchotis rufescens rufescens (Temminck)

♂; Chatarona (600 ft.).

The range of this form apparently extends across the lowlands of Bolivia. Our specimen was taken September 28 and was noted as breeding. The weight of the bird was two pounds.

Rhynchotis rufescens maculicollis G. R. Gray

2 ♂, 4 ♀; Padilla, Sandillani, Samaipata.

A very distinct mountain race. Females taken from December 11 to January 12 were laying.

Nothoprocta ornata ornata (G. R. Gray)

5 ♂, 4 ♀; Chorros, Incachaca, Callipampa, Potosí.

Nothoprocta cinerascens (Burmeister)

♂; Villa Montes.

Nothoprocta pentlandii pentlandii (G. R. Gray)

7 ♂, 5 ♀; Oploca, Padilla, Tanapacá, Tiraque, Incachaca, Ele-Ele.

Breeding specimens were taken from December to April.

Nothura maculosa agassizii Bangs

Nothura maculosa oruro Bond and de Schauensee, Not. Naturae, no. 93, 1941, p. 2 (Callipampa, Oruro, Bolivia).

♂, 2 ♀; Callipampa.

In our description of *N. m. oruro* we mistakenly identified birds from Tiraque as *agassizii* instead of *boliviana*. We find that "*oruro*" at best is but an unstable intermediate, best referred to *agassizii*.

Wing measurements are as follows: *agassizii*, 138.5-149 (6 specimens); "*oruro*," 136.5-142 (3 specimens); *boliviana*, 126-138 mm. (12 specimens).

Mr. Todd has kindly sent us for examination the five specimens of *agassizii* from La Paz and the five specimens of *boliviana* from Cochabamba in the collection of the Carnegie Museum.

Nothura maculosa boliviana Salvadori

3 ♂, 4 ♀; Tiraque, San Lorenzo.

Nothura boraquira (Spix)

♀, o; Buenavista, Chiquitos (D'Orbigny specimen).

Tinamotis pentlandii Vigors

♂, ♀ ad.; ♂, 3 ♀ chicks; Chocaya, Kari-Kari Mts.

The chicks and the adult male were taken June 18.

Order Colymbiformes

Family **COLYMBIDAE** (Grebes)

Colymbus rolland chilensis (Lesson)

♀; Poopó, Rio Desaguadero.

Colymbus occipitalis juninensis (Berlepsch and Stolzmann)

3 ♂; Kari-Kari Mountains (14,500-15,000 ft.).

Centropelma micropterum (Gould)

2 ♂, 4 ♀; Poopó, Callipampa.

This remarkable flightless grebe was hitherto thought confined to Lake Titicaca, whence we have specimens from Desaguadero, Peru, near the Bolivian boundary. The Rio Desaguadero connects Lake Poopó with Lake Titicaca.

A nest of this species, found at Callipampa (Lake Poopó), was the characteristic floating structure composed of a mass of water weeds. The two nest-stained eggs measure 53.1x33.3, 52.9x32.6 mm.

Three other grebes, *Colymbus dominicus brachyrhynchus* Chapman, *Aechmophorus major* (Boddaert), and *Podilymbus podiceps antarcticus* (Lesson), undoubtedly occur in Bolivia.

Order Pelecaniformes

Family **PHALACROCORACIDAE** (Cormorants)

Phalacrocorax olivaceus olivaceus (Humboldt)

Seen by Carriker along the river at Ele-Ele, on the Rio Lipeo, at Fortín Campero, and at numerous other localities.

Order Ciconiiformes

Family **ARDEIDAE** (Herons and Bitterns)

Ardea cocoi Linnaeus

Recorded from the Bolivian Chaco (Tatarenda) by Lönnberg. A "large blue heron" was seen at Entre Rios by Carriker.

Pilherodius pileatus (Boddaert)

♀; Chiñiri.

Butorides striatus striatus (Linnaeus)

♂; Lagunillas.

Casmerodius albus egretta (Gmelin)

♀; vicinity of Santa Cruz.

Syrigma sibilatrix (Temminck)

♀; Lagunillas.

Nycticorax nycticorax hoactli (Gmelin)

o; Buenavista.

Previously recorded from Caiza, Bolivia.

Nycticorax nycticorax obscurus Bonaparte

4 ♂; Callipampa, Tiraque.

The Tiraque specimen is juvenile. This is *N. n. cyanocephala* (Molina) of authors (cf. Hellmayr, Field Mus. Nat. Hist., Zool. Ser., 12, 1932, p. 304).

Tigrisoma bolivianum (Lönnberg)

Known from the Bolivian Chaco (Tatarenda = type locality), south to northern Argentina (Corrientes). We have no specimens.

Ixobrychus exilis erythromelas (Vieillot)

♂, ♀; Chatarona.

Tigrisoma salmoni brevirostre Stolzmann

This species has been recorded from Charuplaya (Ibis, 1919, p. 273).

Family CICONIIDAE (Storks)

Mycteria americana Linnaeus

♀; Chatarona.

Specimens secured at Tatarenda and many seen between Tarija and Caiza (Lönnberg, Ibis, 1903, p. 464).

Euxenura galeata (Molina)

Three specimens secured at Tatarenda (l. c., p. 464).

Family THRESKIORNITHIDAE (Ibises)

Harpiprion caerulescens (Vieillot)

Recorded from the Bolivian Chaco.

Theristicus caudatus (Boddaert)

2 ♂; Chatarona, Rio Azero.

Fairly abundant on the Rio Lipeo.

Theristicus branickii Berlepsch and Stolzmann

Recorded from the temperate highlands of northern Bolivia.

Phimosus infuscatus infuscatus (Lichtenstein)

♂, ♀; Buenavista.

Plegadis ridgwayi (Allen)

♀; Poopó.

Plegadis guarauna (Linnaeus)

Recorded from Fortín Estero, Prov. Tarija, and from the Department of Santa Cruz by Laubmann.

Ajaia ajaja (Linnaeus)

Seen at Fortín Campero by Carriker.

Family **PHOENICOPTERIDAE** (Flamingos)

Phoenicopterus ruber chilensis Molina

♂, o (juv.); Callipampa; near Villazón (12,000 ft.), Dept. Tarija.

The juvenile was collected at the latter locality July 14. The adult had the " iris pale yellow, bill basally pale pink, black apically; legs leaden blue; feet and tibial joints deep rose."

Phoenicoparrus jamesi (Sclater)

♂; Callipampa.

The soft parts are marked as follows: " iris dark blue; eyelids and spot before eye crimson; base of bill ivory; purplish band along base of mandible; top of maxilla salmon-orange; rest of bill black; legs pale drab; tibial joints and feet orange."

Order Anseriformes

Family **ANHIMIDAE** (Screamers)

Anhima cornuta (Linnaeus)

♂; Rio Tchilo (Santa Cruz).

Carriker saw a pair near Fortín Campero in extreme southern Bolivia.

Chauna torquata (Oken)

♂; Buenavista.

Family **ANATIDAE** (Ducks, Geese, and Swans)

Chloëphaga melanoptera (Eyton)

3 ♂; La Cumbre, km. 34 Yungas R. R. (14,000 ft.).

Three downy young taken Jan. 11-13.

Dendrocygna viduata (Linnaeus)

♂; Buenavista.

According to Phillips the only previous Bolivian record for this duck is one given by D'Orbigny in 1842 (Nat. Hist. Ducks, 1, p. 118).

Dendrocygna autumnalis discolor Sclater and Salvin

2 ♂, ♀; Buenavista.

Another tree duck (*Dendrocygna bicolor*) probably occurs in the Bolivian Chaco.

Neochen jubata (Spix)

♂; mouth of the Rio Chapare.

Previously recorded from the Bolivian Chaco.

Cairina moschata (Linnaeus)

♀; Rio Tchilo, Santa Cruz.

Anas cyanoptera orinomus (Oberholser)

Recorded by Ménégaux from the Bolivian Andes.

Anas leucophrys Vieillot

♂, ♀; Lagunillas.

This locality probably represents the northern extremity of the range of this duck. It is a rare species, of which Phillips says " We know less about the distribution, status and life history of this species than of any South American Duck, excepting perhaps the Brazilian Merganser " (l. c., p. 303).

Anas braziliensis Gmelin

2 ♂, ♀, o; Buenavista, Rio Macapani, Santa Cruz (1200 ft.).

These specimens are from the western extreme of the range of this species.

Anas specularioides alticola Ménégaux

4 ♂, 2 ♀; Callipampa, Oploca, Llica.

Specimens taken at Callipampa, on Lake Poopó, are topotypes.

Anas versicolor puna Tschudi

♂, ♀; Callipampa.

The male has a wing of 222 mm.; that of the female measures 210 mm. Apparently Lake Poopó is a new Bolivian locality, for Phillips (l.c., p. 409) says " in Bolivia it is found only about Lake Titicaca."

Anas versicolor versicolor Vieillot

Recorded from Tarija.

Anas flavirostris oxyptera Meyen

2 ♂, 3 ♀; Kari-Kari Mts., Uncia.

Anas spinicauda Vieillot

8 ♂, 2 ♀; Oploca.

This series was secured in February, June, and July. A male shot June 30 and one taken February 26 were in breeding condition.

Anas bahamensis rubrirostris Vieillot

Recorded from Lake Poopó.

Spatula platalea (Vieillot)

Recorded from Bolivia.

Oxyura ferruginea (Eyton)

♂, ♀, ♀ (nestling); Callipampa, Vacas, Cochabamba.

The nestling in down was collected June 7.

Nomonyx dominicus (Linnaeus)

Recorded from Tatarenda by Lönnberg (Ibis, 1903, p. 465).

Merganetta armata garleppi Berlepsch

♀; Incachaca.

The present specimen has the mantle much blacker and the underparts whiter than the figure in Phillips, Natural History of the Ducks (4, pl. 92). The soft parts are described by the collector as follows: "Iris brown; bill red, the ridge blackish; feet blackish horn."

Order Falconiformes

Family CATHARTIDAE (American Vultures)

Vultur gryphus Linnaeus

♂, ♀ imm.; Ele-Ele, Padilla.

Abundant in Chuquisaca (Carriker).

Sarcoramphus papa (Linnaeus)

Seen on the road to the Rio Lipeo, at the mouth of the Rio Coroico, and at Huanay by Carriker.

Coragyps atratus foetens (Lichtenstein)

Recorded from Tarija by Lönnberg (l.c., p. 457) and from Fortín Campero by Carriker. South American specimens average smaller than those from North America, but the validity of *foetens* has been questioned.

Cathartes aura jota (Molina)

♀; Santa Ana.

Recorded by Carriker from Palmar, the Rio Lipeo, and from Fortín Campero. The Turkey Vulture was found over the whole region of the upper Beni in small numbers. The Black Vulture is less common and more local.

Family ACCIPITRIDAE (Hawks)

Elanoïdes forficatus yetapa (Vieillot)

Recorded from Chiquitos and Mojos (D'Orbigny). The species was seen by Carriker at Susi, Chatarona, Chiñiri, Fortín Campero, and between the Rio Lipeo and Bermejo.

Odontriorchis palliatus (Temminck)

♀ ; Susi.

Chondrohierax uncinatus uncinatus (Temminck)

Recorded from Santa Cruz de la Sierra (Friedmann, Journ. Wash. Acad. Sci., 24, no. 7, 1934, p. 317).

Harpagus bidentatus bidentatus (Latham)

Recorded from eastern Bolivia.

Ictinia plumbea (Gmelin)

3 ♂ ; Chiñiri, Yungas of Cochabamba, Fortín Campero.

Accipiter bicolor pileatus (Temminck)

Recorded from Tatarenda by Lönnberg (Ibis, 1903, p. 465).

Accipiter guttifer Hellmayr

2 ♂ , ♀ ; Rio Lipeo, San Lorenzo.

The two males are immature; the female, a fine adult specimen.

Accipiter erythronemius erythronemius Kaup

♂ ; Fortín Campero.

The specimen is not fully adult.

Accipiter erythronemius ventralis Sclater

♂ , ♂ imm.; Incachaca, San Jacinto.

Heterospizias meridionalis meridionalis (Latham)

♂ , ♀ ; Chatarona.

Also recorded from Tarija by Laubmann. The wing of the male measures 386 mm., that of the female 402 mm.

Heterospizias meridionalis australis Swann

" ♂ "; Entre Rios.

This bird is remarkably large, having a wing measurement of 439 mm., which is well above the maximum of that given for even the female of this large southern race, described from Tucumán, Argentina. One suspects it to be wrongly sexed. The barring on the under parts is decidedly blacker and therefore more conspicuous than on specimens of *meridionalis*. This race has previously been recorded only from the Argentine.

Buteo melanoleucus australis (Swann)

♂ imm., ♀ ; Padilla, Tutimayo.

The female is a splendid adult. The white of the under parts is barred with dusky brown, characteristic of this race. The genus *Geranoaetus* has been merged with *Buteo* by Wetmore (Auk, 1933, p. 212).

Buteo albicaudatus albicaudatus Vieillot

♂ ; Padilla.

By its wing formula this bird is referable to this species. Its tail measures 203 mm., which is somewhat longer than the maximum given by Swann.

Buteo (polyosoma) poecilochrous Gurney

♂, ♂ imm.; Callipampa, Tiraque.

Both these birds have the wing formula of *poecilochrous*.

Buteo polyosoma polyosoma (Quoy and Gaimard)

Recorded from western Bolivia.

Buteo magnirostris saturatus (Sclater and Salvin)

5 ♂, 9 ♀; Santa Ana, Chatarona, Palmar, Incachaca, Calabatea, Bermejo, Rio Lipeo, Susi, Tomina, Samaipata, Buenavista.

There is considerable individual variation in this large and handsome race both in regard to color and size. Birds from the Tropical Zone show at least a tendency to be smaller than those of the mountains. An adult male and female from Chatarona have wings of 223 and 259 mm. respectively. Fully adult specimens from other localities have the following wing measurements: ♂, Incachaca (248 mm.), Tomina (255 mm.); ♀, Buenavista (254 mm.), Palmar (265 mm.), Rio Lipeo (266 mm.), Samaipata (287 mm.).

An adult male (wing 232 mm.) in the Academy's collection, taken at La Oroya Inambari, southeast Peru, near the type locality of *occiduus* (Rio Tambopata) is very richly colored below, closely resembling Bolivian specimens in this respect, but the tail is gray with no reddish wash (more or less evident in all Bolivian specimens examined) and the bars on the rectrices are wider and better defined than in birds from farther south. A mere glance at our Peruvian specimens is sufficient to show that there are at least two Peruvian races of this species—a richly colored form in the southeast, a much grayer bird in the north.

A nest, found near Chatarona, September 22, was situated in a tree fifteen feet above the ground. It was very small, "ten inches in diameter and six inches deep." The single egg it contained was about to hatch. This was dirty white, heavily speckled and spotted about the larger end with chestnut ("48 x 38 mm."). The incubating female was collected.

Buteo brachyurus Vieillot

Known to inhabit Bolivia. Swann and Wetmore record a specimen of *Buteo albonotatus abbreviatus* Cabanis as having been taken in Bolivia. We wonder as to accuracy of the locality.

Parabuteo unicinctus unicinctus (Temminck)

Recorded from Villa Montes (Laubmann).

Asturina nitida pallida Todd

This race, apparently of somewhat doubtful validity, was described from a female collected on the Rio Surutú, Bolivia. Laubmann records it from Monte Grande, Santa Cruz. It is supposed to be paler above than the nominate form, but Swann and Wetmore state that a specimen from the lower Beni was darker than true *nitida*.

Leucopternis schistacea (Sundevall)

2 ♂, ♀; mouth of the Rio Chapare.

This species has not hitherto been found as far south as Bolivia.

Hypomorphnus urubitinga azarae (Swann)

2 ♂; Rio Lipeo, Fortín Campero.

The wings of these two birds measure 430 and 436 mm., and the specimens are thus referable to the larger, southern form. Laubmann records a bird from San José, Santa Cruz, which may be *H. u. urubitinga* (Gm.).

Busarellus nigricollis australis Swann

♂; Chatarona.

If the southern form is valid this specimen is referable to it, for its wing measures 410 mm. An adult male from Descalvados, Matto Grosso, is virtually similar in size (wing 409.5 mm.).

Harpyhaliaetus coronatus (Vieillot)

Recorded from Bolivia.

Harpia harpyja (Linnaeus)

Recorded from Bolivia.

Oroaëtus isidori (Des Murs)

Recorded from Charuplaya, Dept. La Paz (Ibis, 1919, p. 284).

Circus cinereus Vieillot

♂, ♂ imm.; Callipampa, Incachaca.

Circus buffoni (Gmelin)

Recorded from Chiquitos (D'Orbigny).

Geranospiza caerulescens flexipes Peters

Proc. Biol. Soc. Wash., 48, 1935, p. 72 (Resistencia, Chaco, Argentina).

♂; Rio Lipeo.

Family FALCONIDAE (Falcons)

Herpetotheres cachinnans queribundus Bangs and Penard

♀; vicinity of Santa Cruz.

Micrastur ruficollis gilvicollis (Vieillot)

♂; Sandillani.

A specimen collected by Simons and recorded by Chubb (Ibis, 1919, p. 280) as *ruficollis* was a juvenile bird and perhaps should have been referred to this race. Our specimen, however, is not typical of *gilvicollis*. The bars on the under parts are black rather than blackish and wider posteriorly than in specimens from Peru and Brazil, and are pronounced even on the flanks. The wings are brownish, and there are a few scattered brownish feathers elsewhere above. The bird is evidently in moult changing from gray-brown to slate-gray on the upper parts.

Micrastur mirandollei mirandollei (Schlegel)

♂; Santa Ana.

This rare bird has not previously been recorded from Bolivia. A race has recently been described from eastern Panama.

Daptrius americanus americanus (Boddaert)

♀; Chiñiri.

Milvago chimachima chimachima (Vieillot)

2 ♀, o; mouth of the Rio Chapare, Buenavista.

Phalcoboenus megalopterus megalopterus (Meyen)

3 ♂; Oploca, Kari-Kari Mts., Potosí, Viloca.

Polyborus plancus subsp.

Recorded from Bolivia (D'Orbigny).

Gampsonyx swainsonii subsp.

Recorded from Bolivia. Swann and Wetmore refer a bird from the Province of Sara to *G. s. magnus* Chubb (Mon. Birds of Prey, pt. 13, 1935, p. 274).

Falco deiroleucus Temminck

Recorded from Bolivia.

Falco albigularis Daudin

♂, 2 ♀; Santa Ana, Todos Santos, Bermejo.

We find no character by which these birds can be separated from *albigularis*. Chubb described *pax* from Bolivia as distinguishable by its slate-gray upper surface and "breast and sides of body dark brown." These characters do not hold in our specimens.

Falco femoralis femoralis Temminck

♂, ♀; Buenavista (1500 ft.).

These two birds, neither of which is fully adult, are very small and have the black abdominal patch unbroken in the center. In these respects they agree with Argentine specimens of *femoralis*.

The wing of the male measures 247.5, that of the female 261.5 mm. A male from San Luis, Argentina, has a wing of 253, while that of a female from the same locality measures 277 mm.

Falco femoralis pichinchae Chapman

2 ♂, 4 ♀; La Cumbre, Oploca, Cataví, San Lorenzo.

The two males have wings of 262 and 271 mm. respectively. The smaller specimen is not fully adult, yet the black abdominal band is interrupted in the center, thereby differing from the Buenavista and Argentine examples. The females have wings of 294, 299, 301, 310 mm. All of these birds are obviously referable to *pichinchae*. They were collected at altitudes of 7500 to 15,000 feet.

Falco sparverius cinnamominus Swainson

8 ♂, 16 ♀; Ele-Ele, San Cristobal, Tomina, Tiraque, Oploca, Callipampa, Chorros, Cataví, San Lorenzo, Calacoto, Llallagua, La Merced, Lagunillas.

Measurements indicate that these birds should be referred to *cinnamominus* rather than to the smaller *cidos* Peters. The wings of the males measure 186-197.5; of females 191-207 mm. There is considerable size variation in any one locality, e.g., two females from San Lorenzo have wings of 192 and 201 mm., respectively.

Order GALLIFORMES

Family **CRACIDAE** (Guans)

Mitu mitu (Linnaeus)

♂, ♀; Chiñiri, mouth of the Rio Chapare.

The male from Chiñiri weighed 7½ pounds.

Pauxi pauxi unicornis Bond and de Schauensee

Pauxi unicornis Bond and de Schauensee, Not. Naturae, no. 29, 1939, p. 1 (above Bolivar, near Palmar (2500 ft.), Yungas of Cochabamba, Bolivia).

♂, ♀; Palmar.

Since we described this bird a form connecting it with *P. pauxi* has been discovered in Colombia and Venezuela.

Crax fasciolata grayi Ogilvie-Grant

Recorded from eastern Bolivia.

Crax globulosa Spix

Recorded from the lower Beni.

Penelope montagnii sclateri G. R. Gray

8 ♂, 7 ♀; Incachaca, Samaipata, Sandillani, San Cristobal, San Jacinto.

These vary considerably in the amount of rufous on the posterior under parts, irrespective of sex. Wing measurements are ♂ 252-271, ♀ 249-273 mm.

Penelope dabbenei Hellmayr and Conover

4 ♂, 2 ♀; Rio Azero, Tomina.

These specimens are evidently referable to this little-known species. Wing measurements are ♂ 295-313, ♀ 288-299 mm.

Penelope jacqûaçu jacqûaçu Spix

Known from the lower Beni.

Penelope jacqûaçu speciosa Todd

2 ♀; Susi, Rio Surutú.

The wings measure 304, 314 mm.

Penelope obscura bridgesi G. R. Gray

5 ♂, 4 ♀; Rio Lipeo, Rio Azero, Lagunillas, Samaipata.

Wing measurements are ♂ 325-347, ♀ 324-338 mm.

Ortalis guttata subaffinis Todd

2 ♂, 4 ♀; Chatarona, Chiñiri, Sandillani, Buenavista, mouth of the Rio Chapare.

The under parts vary from grayish drab to a distinct buff, this being evidently not dependent on locality. A gray male from the mouth of the Rio Chapare differs strikingly from a buff female from the same locality but is similar to a female from Sandillani.

Ortalis canicollis canicollis (Wagler)

♂; Villa Montes.

Pipile cumanenis nattereri Reichenbach

2 ♂, 5 ♀; La Cocha (Rio Coroico), Saupi (Rio Beni), mouth of the Rio Chapare, Samaipata.

Family **PHASIANIDAE** (Pheasants and Partridges)

Odontophorus gujanensis simonsi Chubb

2 ♂, ♀; Rio Chapare, Santa Ana, Rio Coroico.

These birds agree closely with the original description. The female is not quite adult.

Odontophorus speciosus loricatus Todd

This form is known only from three birds taken at the type locality, Cerro Hosane, Santa Cruz, Bolivia. Of it Todd has said "This new species marks the southernmost extension of the genus *Odontophorus* in the Andean region" (Proc. Biol. Soc. Wash., 45, 1932, p. 216).

Odontophorus balliviani Gould

3 ♂, ♀; San Cristobal, Incachaca.

A single male from Incachaca has the under parts brown tinged with olivaceous, not deep brown, and the white spots are smaller. The chin and upper throat are pure buff, instead of brown mixed with buff.

Family **OPISTHOCOMIDAE** (Hoatzins)

Opisthocomus hoazin (P. L. S. Müller)

♂, ♀; Todos Santos.

Order GRUIFORMES

Family **ARAMIDAE** (Limpkins)

Aramus guarauna guarauna Linnaeus

♂ ; Chatarona.

Family **PSOPHIIDAE** (Trumpeters)

Psophia leucoptera leucoptera Spix

o; Rio Tchilo, Santa Cruz.

Family **RALLIDAE** (Rails)

Rallus sanguinolentus sanguinolentus Swainson

♂ ; San Lorenzo.

A specimen, collected at Sicasica by D'Orbigny, may be referable to *R. s. tschudii* (Chubb).

Amaurolimnas concolor castaneus Pucheran

Recorded from eastern Bolivia.

Aramides cajanea cajanea (P. L. S. Müller)

2 ♂, 5 ♀ ; Chatarona, Buenavista, Bermejo, Todos Santos, mouth of the Rio Chapare.

Porzana albicollis albicollis (Vieillot)

♀ ; Chatarona.

This specimen, which is adult, has a wing of 105 mm.

Laterallus melanophaius melanophaius (Vieillot)

Recorded from Chiquitos, Bolivia.

Porphyriops melanops melanops (Vieillot)

Recorded from the llanos of eastern Bolivia.

Porphyrula martinica (Linnaeus)

Recorded from Santa Cruz, Bolivia.

Gallinula chloropus galeata (Lichtenstein)

Recorded from eastern Bolivia.

Gallinula chloropus garmani Allen

2 ♂, 2 ♀, ♂ chick; Oploca.

The chick was collected June 29.

Fulica americana peruviana Morrison

2 ♂ ; Oploca, Callipampa.

The wings of these two specimens measure 229 and 242 mm., respectively. Two sets of eggs of this coot were taken June 7 at Callipampa. These, in color and markings, are typical of those of the genus. They measure (a) 60.2x39.5, 59.6x39.3, 57.8x39, (b) 57.8x38.2, 57.1x38, 55.6x37.7, 54.6x37.2 mm.

Fulica leucoptera Vieillot

Recorded from eastern Bolivia.

Fulica gigantea Eydoux and Souleyet

4 ♂, ♀; Potosí, Uncia, Oploca, Vacas.

Fulica cornuta Bonaparte

The type of this species came from Potosí.

Family **HELIORNITHIDAE** (Sun Grebes)

Heliornis fulica (Boddaert)

Recorded from the lower Beni, Bolivia.

Family **EURYPYGIDAE** (Sun Bitterns)

Eurypyga helias helias (Pallas)

5 ♂; Chatarona, mouth of the Rio Chapare, Samaipata, Rio Surutú.

Family **CARIAMIDAE** (Cariamas)

Cariama cristata (Linnaeus)

Recorded from Bolivia (El Hornero, 6, 1936, p. 348).

Order Charadriiformes

Family **JACANIDAE** (Jacanas)

Jacana spinosa jacana (Linnaeus)

Jacana spinosa dorsalis Brodkorb, Proc. Biol. Soc. Wash., 52, 1939, p. 185 (Horqueta, Paraguay).

♂, 3 ♀; Chatarona, Fortín Campero.

Although our specimens average paler than specimens from the Guianas we believe the difference is seasonal. An example from French Guiana in the Academy's collection has the back even paler than our Bolivian birds. Brodkorb records a specimen from Buenavista as "*dorsalis.*"

Family **CHARADRIIDAE** (Plovers)

Belanopterus chilensis lampronotus (Wagler)

♂, ♀; Bermejo, Fortín Campero.

Hoploxypterus cayanus (Latham)

♀; Buenavista.

Ptiloscelys resplendens (Tschudi)

2 ♂, 2 ♀; La Cumbre, Oploca, Llica.

Pluvialis dominica dominica (P. L. S. Müller)

2 ♂, ♀; Villa Montes, Samaipata.

Charadrius hiaticula semipalmatus Bonaparte

Taken at San Luis, near Tarija, February 6, 1902 (Lönnberg, Ibis, 1903, p. 453).

Charadrius alexandrinus occidentalis (Cabanis)

Three specimens recorded by Chubb from Challapata (12,000 ft.) in October. Two males were in "full summer plumage" (Ibis, 1919, p. 264).

Charadrius alticola (Berlepsch and Stolzmann)

6 ♂, 2 ♀; Llallagua, Uncia, Poopó, Llica, Callipampa.

Charadrius collaris Vieillot

5 ♂, 2 ♀; San Lorenzo, Bermejo, Fortín Campero, mouth of the Rio Chapare.

Oreopholus ruficollis simonsi Chubb

5 ♂, 4 ♀; Uyuni, Llica.

Although Peters does not recognize this race (Check-list Birds of the World, 2, 1934, p. 256), we find it distinguishable from Argentine birds by having the margins to the scapulars and wing-coverts more ochraceous buff. The posterior under parts average deeper buff, but the throat is not deeper rufous as stated by Chubb.

Phegornis mitchellii (Fraser)

2 ♂, ♀; La Cumbre, Potosí.

The pair taken January 4 at La Cumbre (16,000 ft.) were breeding. The female had in the oviduct an egg, not fully developed. The soft parts of this rare bird were noted as "iris brown, bill black, feet yellow or orange yellow."

Family SCOLOPACIDAE (Sandpipers)

Bartramia longicauda (Bechstein)

♀; Chatarona.

Tringa flavipes (Gmelin)

2 ♂, 3 ♀; Callipampa, Fortín Campero, Oploca.

Tringa melanoleuca (Gmelin)

Recorded from the falls of the Rio Madeira in October.

Tringa solitaria solitaria Wilson

Recorded by Laubmann from San José, Santa Cruz, September 8.

Tringa solitaria cinnamomea (Brewster)

♀; Todos Santos.

This specimen has a wing of 138 mm. and is thus referable to the western race.

Actitis macularia (Linnaeus)

Recorded from Bolivia (San Francisco; lower Rio Beni), and from Tarija.

Catoptrophorus semipalmatus semipalmatus (Gmelin)

Recorded from Bolivia (Bull. Liverpool Mus., 2, no. 2, 1899, p. 384).

Capella paraguaiae andina (Taczanowski)

3 ♂; Callipampa, Oploca, Tiraque.

Apparently not previously recorded from Bolivia. These birds are indistinguishable from a series from Peru in the Academy's collection.

Chubbia jamesoni (Bonaparte)

A species that ranges from Bolivia to Colombia, inhabiting the Paramo Zone.

Erolia fuscicollis (Vieillot)

This migrant from North America has been recorded from Las Taperas, Prov. Santa Cruz (Laubmann).

Erolia bairdii (Coues)

♂, 2 ♀; Llica, Callipampa.

Erolia melanotos (Vieillot)

2 ♂; Oploca, La Paz (13,000 ft.).

Micropalama himantopus (Bonaparte)

2 ♀; Callipampa.

Family **RECURVIROSTRIDAE** (Avocets and Stilts)

Himantopus himantopus melanurus Vieillot

♂, ♀; Callipampa.

Recurvirostra andina Philippi and Landbeck

6 ♂, ♀; Llica, Callipampa.

Family **THINOCORIDAE** (Seed-snipe)

Attagis gayi simonsi Chubb

3 ♂, 2 ♀; Cerro del Juno, La Cumbre.

Thinocorus orbignyianus ingae Tschudi

15 ♂, 9 ♀; Potosí, Uyuni, Chocaya, Llica, La Cumbre, Catavi, Uncia, Callipampa.

Thinocorus rumicivorus bolivianus Lowe

12 ♂, 3 ♀; Uyuni.

These specimens are virtually topotypes. Two of the birds are in juvenal plumage.

Family **LARIDAE** (Gulls and Terns)

Larus cirrocephalus cirrocephalus Vieillot

Said to cross Bolivia in order to reach the coast of Peru (El Hornero, 6, 1936, p. 361).

Larus serranus Tschudi

3 ♂, 2 ♀; La Cumbre, Poopó, Tutimayo.

A female from La Cumbre had enlarged ovaries (Jan. 4).

Phaetusa simplex chloropoda (Vieillot)

♂, 2 ♀; mouth of Rio Chapare, El Encuentro (Rio Beni).

Family **RYNCHOPIDAE** (Skimmers)

Rynchops nigra cinerascens Spix

2 ♂, 2 ♀; El Encuentro (Rio Beni).

These birds were all taken September 9, and were in breeding condition.

Order COLUMBIFORMES

Family **COLUMBIDAE** (Pigeons)

Columba picazuro picazuro Temminck

2 ♂, ♀; Buenavista, Villa Montes.

Columba maculosa maculosa Temminck

Recorded from the Department of Tarija.

Columba maculosa albipennis Sclater and Salvin

6 ♂, ♀; Oploca, Ele-Ele.

Columba cayennensis sylvestris Vieillot

2 ♂, 5 ♀; Villa Montes, Chiñiri, Chatarona, Samaipata.

Columba fasciata albilinea Bonaparte

4 ♂, 4 ♀; Incachaca, Sandillani.

Colombian birds have the crown slightly less vinaceous, and the mantle a trifle more metallic than Bolivian birds. They also appear to average slightly larger. The differences are insignificant, and we do not think sufficient to warrant recognition of a Bolivian race. Perhaps Bolivian birds show an approach to *C. f. tucumana* Salvadori, which we have not seen.

Columba speciosa Gmelin

♂, ♀; Chiñiri.

Columba subvinacea ogilvie-granti Chubb

♂, 3 ♀; Buenavista, Chiñiri, mouth of the Rio Chapare, Todos Santos.

Columba plumbea bogotensis (Berlepsch and Leverkühn)

2 ♂, 3 ♀; San Jacinto, Santa Ana.

Zenaidura auriculata virgata (Bertoni)

9 ♂, 2 ♀; Oploca, Tutimayo, Incachaca, San Lorenzo, Calacoto, Buenavista.

The single female from the Department of La Paz has the posterior under parts somewhat paler and thus approaches the more northern *hypoleuca* (Bonaparte).

Gymnopelia ceciliae gymnops Chubb

14 ♂, 7 ♀; Tutimayo, Calacoto, Cochabamba, Oploca, Llallagua, Callipampa, Tiraque.

Columbigallina talpacoti talpacoti Temminck

2 ♂, 3 ♀; Susi, Entre Rios, Bermejo.

Columbina picui picui (Temminck)

7 ♂, 5 ♀; Buenavista, San Lorenzo, Chatarona, Calacoto, Incachaca, Oploca.

Leptophaps aymara (Knip and Prévost)

4 ♂, 4 ♀, 4 o; Callipampa, Chocaya, Uyuni, Cataví, Oploca.

Uropelia campestris (Spix)

Known from eastern Bolivia (Chiquitos district). Pinto states that *U. c. figginsi* Oberholser is not valid (Rev. Museu Paulista, 22, 1937, p. 164).

Claravis pretiosa (Ferrari-Perez)

3 ♂, ♀; Santa Ana, Buenavista, Todos Santos, Bermejo.

Claravis mondetoura subsp.

♀; Incachaca.

This specimen more closely resembles a female from western Colombia than it does a female from Oconeque, southeast Peru. The latter is strongly washed with rufous above, showing virtually no olivaceous tinge. Van Rossem has described *inca* from southeastern Peru (Huasampilla, Dept. Cuzco), based on a single male. Among characters given is small size (wing 111 mm.), but our southeast Peru female has a wing of 122 mm. Our Bolivian specimen has a wing of 117 mm., while that of the female from Colombia, above referred to, measures 119 mm.

Metriopelia melanoptera melanoptera (Molina)

8 ♂, 4 ♀; Colomi, Callipampa, Tutimayo, Oploca.

Leptotila verreauxi decipiens (Salvadori)

6 ♂, 3 ♀; Todos Santos, Teoponte, Santa Ana, Chiñiri, Ele-Ele, Rio Lipeo, Tomina, Fortín Campero.

All of these specimens, except a male from Ele-Ele, have wings of less than 150 mm. That of the Ele-Ele example measures 153.5 mm., which is

over the maximum (150 mm.) given for *decipiens* by Hellmayr and Conover. An adult male from Fortín Campero in extreme southern Bolivia has a wing of 146.5 mm. and is thus referable to *decipiens* rather than to *chlorauchenia* (Giglioli and Salvadori).

Leptotila megalura megalura Sclater and Salvin

5 ♂, 3 ♀; San Cristobal, Samaipata, Rio Azero, Sandillani, Padilla.

Birds from extreme southern Bolivia (Dept. Tarija) differ from those from the northern Yungas, and are best referred to *saturata*.

Leptotila megalura saturata Salvadori

2 ♂, ♀; La Merced, Rio Bermejo.

Not hitherto recorded from Bolivia.

Leptotila rufaxilla dubusi Bonaparte

2 ♂, 2 ♀; Palmar, Chiñiri, Huanay.

This species has not hitherto been recorded from Bolivia. Our specimens are similar in size and coloration to a series from Peru and Ecuador.

Oreopeleia violacea violacea (Temminck)

♀ imm.; Teoponte.

This species does not appear to have been previously recorded from Bolivia.

Oreopeleia montana montana (Linnaeus)

4 ♂, 2 ♀; mouth of the Rio Chapare, Palmar, Todos Santos, Chiñiri.

Oreopeleia frenata frenata (Tschudi)

3 ♂, 4 ♀; Rio Lipeo, San Jacinto, Samaipata, Incachaca, Sandillani.

Family **PSITTACIDAE** (Parrots)

Ara ararauna (Linnaeus)

♂, ♀; Chatarona.

Ara caninde (Wagler)

Recorded from Santa Cruz, Chuquisaca, and Tarija (El Hornero, 6, 1937, p. 537).

Ara militaris (Linnaeus)

♀, o; Rio Azero, "Bolivia".

The Rio Azero female has a wing of 371 mm. which is larger than in two females from the Rio Chinchipe, Cajamarca, Peru, which have wings of 351 and 358 mm., respectively. The unsexed Bolivian specimen (Rivoli Collection) has a wing of 388 mm. Measurements of the Bolivian birds agree well with those of the northern "*mexicana.*" We have no Colombian specimens of this species, but since Ridgway gives 373 mm. as average wing

measurements for three Colombian females (U. S. Nat. Mus., Bull. 50, pt. 7, 1916, p. 133), and since Mexican examples merely average larger than those from South America, we follow Todd and Carriker (Ann. Carnegie Mus., 14, 1922, p. 208) in not recognizing either *mexicana* Ridgway or *boliviana* Reichenow. Two females from Mexico in the Academy's collection have wings of 366 and 370 mm., respectively. We can see no color difference distinguishing Mexican specimens from Peruvian and Bolivian birds.

Ara macao (Linnaeus)

Recorded from Bolivia.

Ara chloroptera G. R. Gray

♂ ; Chatarona.

Ara rubro-genys Lafresnaye

♂ ; Ele-Ele.

The soft parts are marked by the collector as "iris orange (eye-skin pink); bill black; feet black."

Of this rare and very distinct macaw there are in the Academy's collection four additional specimens (Rivoli Collection), all marked "Bolivia," but without exact locality. The distribution of this species must be very circumscribed for it does not appear to have been recorded from anywhere except Bolivia.

Ara auricollis Cassin

3 ♂, 3 ♀ ; Santa Cruz, Rio Lipeo.

The type, said to have been taken in Bolivia, is in the Academy's collection. There is no definite locality given on the label, merely "South America."

Ara severa castaneifrons Lafresnaye

2 ♂, 5 ♀ ; Rio Surutú, Palmar, Chiñiri, Todos Santos.

Aratinga acuticaudata acuticaudata (Vieillot)

12 ♂, 3 ♀ ; Ele-Ele, Samaipata, Tomina, Buenavista.

Aratinga mitrata mitrata (Tschudi)

3 ♂, 3 ♀ ; Samaipata, La Merced, Lagunillas.

Aratinga leucophthalmus leucophthalmus (P. L. S. Müller)

5 ♂, 2 ♀ ; Chatarona, mouth of the Rio Chapare, Rio Surutú.

These birds have more or less red on the cheeks but are paler green than specimens from Ecuador and Peru. They also average somewhat smaller (wings, ♂ 175-181, ♀ 173, as against ♂ 179-194, ♀ 176-184 for Ecuador and Peru specimens). The amount of red on the cheeks is variable in this series as well as in a series from Peru and Matto Grosso.

Aratinga weddellii (Deville)

3 ♂, 2 ♀; Todos Santos.

A male taken August 9 was in breeding condition.

Aratinga aurea aurea (Gmelin)

3 ♂, 2 ♀; Chatarona.

Aratinga aurea major (Cherrie and Reichenberger)

A single specimen, with no label, obtained by Carriker in 1937, presumably came from southern Bolivia and evidently belongs to this race. It has a wing of 158 as against 138-148 mm. for *A. a. aurea.*

Nandayus nenday (Vieillot)

Recorded from Bahia Blanca, southeast Bolivia (Orfila, El Hornero, 1937, p. 367). Brodkorb has recently described *N. n. campicola* from 265 miles west of Puerto Casado, Paraguay (Occ. Pap. Mus. Zool., Univ. Mich., no. 367, 1938, p. 2).

Pyrrhura devillei (Massena and Souancé)

Recorded from eastern Bolivia.

Pyrrhura molinae molinae (Massena and Souancé)

7 ♂, 5 ♀, o; Samaipata, Calabatea, Palmar, San Cristobal, Incachaca, Yungas of Cochabamba, San Jacinto, Santa Ana, Chatarona.

Pyrrhura molinae australis Todd

5 ♂, 5 ♀; Rio Azero, Bermejo, Rio Lipeo, Villa Montes.

These specimens were taken near the type locality of *australis* (Rio Bermejo, Salta, Argentina). They differ from our examples of *molinae* in slightly smaller size, narrower pale barring on throat and breast, more red on the abdomen, and less blue on the under tail-coverts. The upper parts are similar. All these differences are average, but in series the two races can readily be distinguished. Wing measurements of males of *molinae* are from 128.5 to 140 mm., of females from 131-133 mm. Those of males of *australis* are from 129.5-131.5, of females from 125-132 mm.

Pyrrhura picta lucianii (Deville)

♀; Teoponte.

In breeding condition August 16. Not previously recorded from Bolivia. This specimen differs from a single female from Sandia, southeastern Peru, by its smaller size (wing 122 vs. 128, tail 82 vs. 104, culmen 14 vs. 16 mm.). It has a little red at the bend of one wing which the Peruvian specimen lacks, and the lower cheeks are tinged with greenish blue instead of red.

Pyrrhura rupicola (Tschudi)

Recorded from the Yungas of Bolivia.

Myiopsitta monachus cotorra (Vieillot)

Recorded from Tarija.

Myiopsitta monachus luchsi (Finsch)

5 ♂, 5 ♀; Ele-Ele.

Of this little known and very distinct parrot Carriker says "Several flocks of these birds were seen at Ele-Ele .... moving up in the valley. They are not particularly shy. They were always seen along the river in heavy vegetation."

The gray portion of the plumage is a beautiful dove-gray, not brownish gray as shown in the plate (pl. IV, vol. XX) in the Catalogue of Birds of the British Museum.

Amoropsittaca aymara (D'Orbigny)

13 ♂, 11 ♀; Tutimayo, Padilla, Ele-Ele, Cochabamba, Tiraque, Oploca, San Lorenzo, La Merced.

Psilopsiagon aurifrons orbygnesius (Souancé)

8 ♂, 6 ♀, 2 o; Tiraque, Uyuni, Tutimayo, Chocaya, Potosí, Llallagua, Callipampa.

Bolborhynchus andicolus (Finsch)

4 ♂, ♀; Incachaca, Cerro del Juno, Posona (Cochabamba, 7500 ft.).

New to the avifauna of Bolivia. In no way different from Peruvian birds.

Forpus passerinus flavescens (Salvadori)

♂, ♀; near Santa Cruz (1300 ft.).

Brotogeris versicolurus chiriri (Vieillot)

3 ♂, ♀; Chatarona, Buenavista.

Chatarona birds, taken September 22, are in very worn plumage. Wings of males measure 118, 119, 124, that of the female 118 mm.

Brotogeris versicolurus behni Neumann

2 ♀; Ele-Ele.

These birds, taken October 15, are in fresh plumage. They show wing measurements of *behni* as given by Neumann (131, 135.5 mm.).

Brotogeris cyanoptera (Salvadori)

7 ♂, 2 ♀; Todos Santos, Chatarona, Susi.

These specimens resemble examples from Peru in the collection of the Academy (Puerto Indiana, Puerto Yessup).

Brotogeris chrysopterus beniensis Gyldenstolpe

Brotogeris gustavi beniensis Gyldenstolpe, Arkiv för Zool., 33 B, no. 13, 1941, p. 9 (Victoria, confluence of Rio Madre de Dios and Rio Beni, Distr. Madre de Dios, Bolivia).

5 ♂, ♀; Chatarona, Susi.

A male from Susi agrees with the description of *beniensis*. The remainder are apparently hybrids (*cyanoptera* × *beniensis*). A second male from Susi has the right wing as in *beniensis* but with less yellow on the left wing. A male and female from Chatarona have no yellow on the right wing, although some of the primary coverts on the left wing are yellow (four and three feathers, respectively). Two other males from Chatarona have a little yellow on both wings.

We have before us a small series (3 ♂, 2 ♀) of *B. gustavi*, taken at Saposoa and Moyobamba in the Department of San Martin, Peru. These have the shoulder and bend of wing yellow and are quite uniform, except that the Moyobamba birds are much paler, less yellowish green below, thus resembling in this respect the Bolivian *beniensis*, from which they are at once distinguished by having the entire shoulder yellow and the primary coverts violet instead of yellow.

We have examined specimens of *B. ch. chrysosema* in the collection of the American Museum of Natural History. This form, which is found in northeastern Matto Grosso, near the type locality of *beniensis*, may be distinguished by its well defined orange-yellow speculum, and thus tends toward *chrysopterus* and *tuipara* of northeastern South America, which have an orange speculum.

Hapalopsittaca melanotis melanotis (Lafresnaye)

6 ♂, 2 ♀, o; Incachaca.

H. m. peruviana Carriker, from Junín, Peru, is a well marked form.

Pionus menstruus (Linnaeus)

6 ♂, 2 ♀, o; Santa Ana; mouth of the Rio Chapare, Chiñiri, Huanay, Palmar, Todos Santos.

Pionus sordidus corallinus Bonaparte

4 ♂; Incachaca, Samaipata, " Bolivia " (Wilson Collection).

These birds resemble specimens from eastern Ecuador in the collection of the American Museum of Natural History, viz. a male from Baeza and a male and female from lower Sumaco. The Bolivian examples show some variation. For instance, a male from Incachaca is much greener, less glaucous than a male from Samaipata. The wing-coverts have no "pronounced darker margins", one of the characters on which Chapman's *"mindoensis"* of west Ecuador was based. A Rusby specimen in the American Museum, said to have been collected in the Yungas of Bolivia, is more yellowish green above, and resembles *"mindoensis"*, which has been pointed out by Chapman (Amer. Mus. Novit., no. 187, 1925, p. 2), as do specimens from northern Peru (Chaupé). Although the type locality of *corallinus* has been restricted by Chapman to "eastern Colombia" (l.c., p. 2), a "Bogotá" specimen in the American Museum is like west Ecuador skins. No other Colombian skins

of the red-billed bird have been seen by us. In view of the foregoing, we doubt if *mindoensis* Chapman can be maintained.

This parrot has a remarkably disconnected range, being unknown from central and from southern Peru.

Pionus maximiliani siy Souancé

2 ♂; Buenavista.

These birds have wings of 186.5 and 190 mm., respectively, and are intermediate in size between Matto Grosso specimens (wings 171-186 mm.) and birds from Chuquisaca and Tarija. In color they resemble Matto Grosso birds.

Pionus maximiliani lacerus Heine

4 ♂, 2 ♀; Rio Lipeo, Villa Montes, Rio Azero.

These are larger and darker than Matto Grosso specimens. They have wings of 189-202 mm.

Pionus tumultuosus (Tschudi)

♂, 2 ♀; Incachaca, San Cristobal.

Amazona tucumana (Cabanis)

7 ♂, 2 ♀; Fortín Campero, Rio Lipeo, Padilla.

This parrot, which is apparently new to the avifauna of Bolivia, we regard as specifically distinct from *pretrei* Temminck, since the two forms are recorded as occurring in Missiones, Argentina (El Hornero, 6, 1937, p. 535).

A female, taken at Padilla, January 12, was incubating a clutch of four eggs. These measure 36.2x25.3, 34.1x27.5, 34x27.3, 33.6x26.7 mm.

Amazona aestiva xanthopteryx (Berlepsch)

5 ♂, 4 ♀; Bermejo, Fortín Campero, Samaipata, Rio Lipeo, Ele-Ele, Lagunillas.

Amazona amazonica amazonica (Linnaeus)

2 ♂, 2 ♀; Todos Santos, Rio Surutú.

New to Bolivia.

Amazona mercenaria mercenaria (Tschudi)

♂, 2 ♀; Calabatea, Palmar, Incachaca.

Amazona farinosa farinosa (Boddaert)

4 ♀; Mouth of the Rio Chapare, Rio Surutú, Santa Ana.

Previously recorded from the Province of Sara by Ridgway (Birds of North and Mid. Amer., pt. 7, 1916, p. 239). Only one of our specimens (from the Rio Surutú) shows a trace of yellow on the pileum. A male from Pará, Brazil, resembles our Bolivian birds, which are larger (wing 253-259 mm.) and more "mealy" above than Panama examples (*inornatus*).

Family **CUCULIDAE** (Cuckoos)

Coccyzus cinereus Vieillot

♀; Lagunillas.

Coccyzus americanus subsp.

Recorded from Tarija.

Coccyzus melacoryphus Vieillot

2 ♂, 3 ♀; Entre Rios, Lagunillas.

Piaya cayana boliviana Stone

8 ♂, o; Incachaca, Todos Santos, Palmar, mouth of the Rio Chapare, Yungas of Cochabamba.

A single dull white egg was taken from a nest found near Susi, September 15. The nest was situated on top of a stump, surrounded by a thick growth of sprouts. The egg, which was fresh, measures 30.7x23.5 mm.

For a discussion of *Piaya cayana* see Griscom and Greenway (Bull. Mus. Comp. Zool., 88, no. 3, 1941, pp. 151-152).

Piaya cayana mogenseni Peters

7 ♂, 2 ♀; La Merced, Rio Azero, Bermejo, Fortín Campero, Ele-Ele, Tomina, Entre Rios, Samaipata.

Birds taken in October, November, and December are in very worn plumage and differ from those in fresh plumage in having the tail cinnamon instead of purplish brown, and the back very pale.

Piaya minuta chaparensis Cherrie

♀; Todos Santos.

This specimen is a topotype of *chaparensis,* which was based on two males taken at Todos Santos. Cherrie compared his specimens with *panamensis,* from which our bird differs in the manner in which he stated in the original description. In its dark coloring it resembles the nominate form, but differs in having the belly and flanks decidedly grayer, less brown. A male in the Academy's collection from northern Peru (Moyobamba, Dept. San Martin) is evidently nearest to *chaparensis,* differing chiefly in having the throat and chest a trifle darker brown. Measurements of the Moyobamba male are: wing 108, tail 155, exposed culmen 20 mm.; of the Bolivian female, wing 108.5, tail 152, exposed culmen 18 mm.

Crotophaga major Gmelin

Recorded from Bolivia (El Hornero, 6, 1937, p. 542).

Crotophaga ani Linnaeus

♂, ♀; Todos Santos.

Guira guira (Gmelin)

7 ♂, ♀; Chatarona, Todos Santos, Samaipata, San Lorenzo.

Tapera naevia chochi (Vieillot)

2 ♂; Chatarona, Samaipata.

The wings of these two birds measure 110.5, 111 mm., respectively.

Dromococcyx phasianellus phasianellus (Spix)

♀; mouth of the Rio Chapare.

Neomorphus geoffroyi australis Carriker

Proc. Acad. Nat. Sci. Phila., 87, 1935, p. 316 (Huanay, 1500 ft., Dept. La Paz, Bolivia).

2 ♀; Huanay (type), Santa Ana.

Family **TYTONIDAE** (Barn Owls)

Tyto alba tuidara (J. E. Gray)

♂; Tiraque.

Family **STRIGIDAE** (Typical Owls)

Otus guatemalae bolivianus Bond and de Schauensee

Not. Naturae, no. 93, 1941, p. 2 (Mouth of Rio Chapare, Dept. Cochabamba, Bolivia).

♂; Mouth of the Rio Chapare.

This beautiful little owl is known only from the type.

Otus choliba wetmorei Brodkorb

3 ♂, 3 ♀; Buenavista, Ele-Ele, Padilla, Rio Azero.

Our specimens agree with a topotype in the Academy's collection from Puerto Casado, Paraguay. We have not seen the nominate race. An incubating female was taken at Ele-Ele, October 17.

Otus watsonii usta (Sclater)

O. watsonii is recorded from Bolivia in El Hornero (6, 1937, p. 545).

Otus albo-gularis remotus Bond and de Schauensee

Not. Naturae, no. 93, 1941, p. 3 (Incachaca, Dept. Cochabamba, Bolivia).

♂; Incachaca.

Known only from the type.

Otus minimus (Carriker)

Ciccabo minima Carriker, Proc. Acad. Nat. Sci. Phila., 87, 1935, p. 313 (Santa Ana, Dept. La Paz, Bolivia).

♂; Santa Ana, Rio Coroico.

This large *Otus* may be related to *O. ingens* Salvin, of eastern Ecuador, which we have not seen. Both species are known only from the type. The wing of *O. minimus* measures 195 mm. That of *ingens* is said to measure 8.1 inches. (=206 mm., fide Chapman.)

Bubo virginianus nacurutu (Vieillot)

♂, 3 ♀; La Cumbre, Tiraque, San Lorenzo.

Pulsatrix perspicillata boliviana L. Kelso

Known from southern Bolivia and northern Argentina.

Glaucidium brasilianum brasilianum (Gmelin)

3 ♂, ♀; Susi, Ele-Elc, Lagunillas, Villa Montes.

On geographical grounds we might refer our specimens to *pallens* Brodkorb. Owing, however, to the very great variation in color exhibited in this species we are not convinced of the validity of *pallens*. A large series from Peru show all extremes of coloration. *G. brasilianum* is badly in need of revision, based on adequate material.

Glaucidium jardinii jardinii (Bonaparte)

♀ imm.; San Cristobal.

This species has not previously been recorded from Bolivia. The wing of this specimen measures 103 mm.

Speotyto cunicularia juninensis Berlepsch and Stolzmann

5 ♂, 3 ♀; Uyuni, Catavi, Cerdas.

The wings of the males measure 203-205 mm., those of the females 203.5-211 mm. Two topotypes from Junín, Peru, have wings of 199 (♂), 204 (♀). We refer our Bolivian birds to *juninensis*, although the barring below is a trifle less heavy and the ground color is somewhat whiter than in Peruvian examples.

Speotyto cunicularia cunicularia (Molina)

♂; "Bolivia" (wing 185 mm.).

Burrowing owls, taken at Tatarenda in the Bolivian Chaco (Lönnberg, Ibis, 1903, p. 466), are said to have wings measuring 183-186 mm., and are thus presumably referable to *cunicularia*. These are said to be paler than specimens from Jujuy, Argentina.

Two specimens from Puerto Casado, Paraguay, in the Academy's collection have wings of 177 (♂) and 183 (♀). They appear to be referable to *grallaria* (Temminck).

Ciccaba virgata superciliaris (Pelzeln)

♀; Huanay.

This specimen is apparently referable to *superciliaris*, being very different from *borelliana* Bertoni of southern Brazil and Paraguay. It agrees closely with a female from the lower Rio Madeira and with another female from Mission San Antonio, Rio Chimoré (1300 ft.), Dept. Cochabamba, Bolivia, in the collection of the American Museum of Natural History. The posterior under parts are whiter, less heavily marked with reddish brown in our specimen, and it is paler above, the barring buffy-white rather than rufous as in the other two. Our example has the superciliaries tinged with

pinkish, but these are pure white in the bird from the Rio Chimoré, which was collected August 9. Our Huanay specimen was taken August 7. The species does not appear to have been previously recorded from Bolivia.*

Asio clamator clamator (Vieillot)

♀ ; Chatarona.

Apparently new to the avifauna of Bolivia. The wing of this specimen measures 269 mm. Although *A. clamator* has larger feet and a much larger bill than typical *Asio*, we do not consider these characters warrant recognition of the genus *Rhinoptynx*.

Asio flammeus suinda (Vieillot)

Recorded from southern Bolivia.

Family NYCTIBIIDAE (Potoos)

Nyctibius griseus cornutus (Vieillot)

♂ ; Rio Surutú, Dept. Santa Cruz.

Carriker notes that Steinbach has an egg of this species taken at Buenavista.

Family CAPRIMULGIDAE (Nightjars)

Chordeiles rupestris rupestris (Spix)

Recorded from northeastern Bolivia.

Podager nacunda nacunda (Vieillot)

4 ♂, 3 ♀ ; Todos Santos, Fortín Campero.

One specimen from Fortín Campero is marked " ♂," but we believe it to be a female for it lacks the broad white band on the outer tail-feathers.

Nyctidromus albicollis albicollis (Gmelin)

♀ ; Santa Ana.

This specimen clearly belongs to the nominate form, which has not previously been recorded from Bolivia.

The Beni district evidently marks the southernmost limit to the range of the widespread *albicollis* in western South America. Typical *derbyanus*, the only form hitherto known from Bolivia, was found at nearby localities, so it is probable that the two races meet in this area, although our specimens show no intermediate characters. The above example was collected July 29.

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* Peters and Griswold say that " Mr. Todd expects shortly to describe an additional race from Bolivia " of *Ciccaba albitarsus* (Bull. Mus. Comp. Zool., 92, no. 4, 1943, p. 298).

Nyctidromus albicollis derbyanus Gould

5 ♂, 2 ♀; Buenavista, Todos Santos, Chatarona, Susi.

These birds agree well with a Descalvados example. The range of this form is extended to western Bolivia close to the range of *N. a. albicollis*. The Beni specimens were taken from September 12 to 22, those from Rio Chapare from August 10 to September 17.

Caprimulgus rufus rutilus (Burmeister)

3 ♂, ♀, juv. ♀; Samaipata, Lagunillas, Rio Azero.

New to Bolivia. The juvenile was taken November 14.

Caprimulgus longirostris atripunctatus (Chapman)

♂, 5 ♀; Sandillani, Hichuloma, Tanapacá, Palmar, Incachaca.

A single specimen from Palmar is a trifle darker, less gray, than the rest of the series.

Caprimulgus maculicaudus romainei (Carriker)

Antiurus maculicaudatus (sic) *romainei* Carriker, Proc. Acad. Nat. Sci. Phila., 87, 1935, p. 320 (Chatarona, Dept. Beni, Bolivia).

♂ (type), ♀; Chatarona, Todos Santos.

In addition to the type from Chatarona, Carriker secured a female of this form at Todos Santos. It differs from *maculicaudus* (topotypes examined) more than does the male, being very much lighter than a single female from Pará, Brazil. Pará males are a little darker than the single male of *romainei*.

We have no south Brazil specimen (*platurus* Pelzeln) and as Peters points out (Birds of the World, 4, p. 202) there is a possibility that *romainei* may be a synonym of this form. Mrs. Naumberg does not record the species from Matto Grosso.

Caprimulgus parvulus parvulus Gould

7 ♂, 2 ♀; Chatarona, Lagunillas, Villa Montes, Rio Lipeo.

Four males from Chatarona, taken September 22, are marked as having the testes much enlarged. Males from Lagunillas and Villa Montes, taken in November, were likewise in breeding condition.

This species has been previously recorded by Laubmann from Santa Cruz and Tarija.

Caprimulgus nigrescens australis (Gyldenstolpe)

Nyctipolus nigrescens australis Gyldenstolpe, Arkiv för Zool., 33 B, no. 13, 1941, p. 8 (Cachuela Esperanza, right bank of the Rio Beni, Dept. El Beni, Bolivia).

This race is also found in southeastern Peru (l.c., p. 9).

Hydropsalis climacocerca subsp.

4 ♂, 3 ♀; Chiñiri.

Agrees with the description of *H. c. canescens* (Griscom and Greenway) from the lower Tapajoz, although it was the nominate form that was previously recorded from Bolivia. As Griscom and Greenway have pointed out (Bull. Mus. Comp. Zool., 88, no. 3, 1941, p. 164), a good series from the Rio Ucayali, Peru, is needed to show the exact subspecific characters of *climacocerca*.

Hydropsalis brasiliana furcifera (Vieillot)

6 ♂, 8 ♀; Calabatea, Todos Santos, Ele-Ele.

Among our females there are apparently two color phases. Six females from Todos Santos are noticeably grayer than others from the same locality. The latter two are matched by Calabatea females. Among the males there is no marked difference. A female from Calabatea is recorded as incubating (Nov. 11), while males from Ele-Ele had enlarged testes (Oct. 11).

Uropsalis segmentata subsp.

♀; Incachaca.

We have no comparative material.

Family **APODIDAE** (Swifts)

Streptoprocne zonaris zonaris (Shaw)

We have no Bolivian specimens.

Chaetura cinereiventris egregia Todd

Known only from the Rio Surutú, Bolivia.

Chaeturellus rutila brunnitorques (Lafresnaye)

♂; Palmar.

New to Bolivia. Similar in size to Colombian and Peruvian examples, but with the orange-rufous of the throat and breast darker. The Bolivian bird will perhaps prove separable.

Peters has removed this species to the genus *Chaetura*, but its nesting habits resemble those of the members of the genera *Cypseloides* and *Nephoecetes*, not *Chaetura* (Check-List Birds of the World, 4, 1940, p. 243). We follow the advice of Mr. Charles Rogers of Princeton University, an authorithy on swifts, in placing this species in the genus *Chaeturellus* Mathews.

Cypseloides major Rothschild, has been recorded as of doubtful occurrence in southern Bolivia.

Apus andecolus andecolus (D'Orbigny and Lafresnaye)

♂, 2 ♀; Calacoto, Oploca.

Aeronautes montivagus montivagus (D'Orbigny and Lafresnaye)

Carriker obtained this swift at Anguimarca, Junín, Peru, but not in Bolivia. The type locality is Santa Cruz de la Sierra, Bolivia.

Family TROCHILIDAE (Hummingbirds)

Doryfera ludoviciae ludoviciae (Bourcier and Mulsant)

Doryfera ludoviciae grisea Carriker, Proc. Acad. Nat. Sci. Phila., 87, 1935, p. 317 (Calabatea, 4600 ft., Dept. La Paz, Bolivia).

♂ ; Calabatea.

The above specimen, which is not fully adult, can be matched in a series from Ecuador.

Threnetes leucurus rufigastra Cory

♀ ; Todos Santos.

This specimen agrees best with *rufigastra* Cory, of which we have two males from Saposoa, which is very near Moyobamba, Peru, the type locality. Compared with specimens of *leucurus* from Surinam (the type locality), Venezuela (Mt. Auyan-tepui) and from the Rio Madeira, Brazil, the above Peruvian and Bolivian birds have the abdomen ochraceous, rather than white or whitish. A female from Teffé, Rio Solimoes, Brazil approaches *rufigastra.* It resembles the Todos Santos female but lacks the cinnamon wash on the chest. The Saposoa and Todos Santos specimens do not have the back " more bronzy green " than specimens of *leucurus.*

We wish to thank Mr. John T. Zimmer of the American Museum of Natural History for the loan of comparative material now in that institution.

Glaucis hirsuta hirsuta (Gmelin)

4 ♂ , ♀ ; Susi, Todos Santos, Chiñiri.

We follow Todd (Ann. Carnegie Mus., 29, 1942, p. 275) in referring Bolivian birds to the nominate race, at least provisionally. The color variation in this hummingbird is considerable and the discrimination of races is thus impossible without much material.

Phaethornis superciliosus bolivianus Gould

3 ♂ , ♀ ; Santa Ana, Palmar, Chiñiri.

Phaethornis hispidus hispidus (Gould).

3 ♂ , 2 ♀ ; Mouth of the Rio Chapare, Chiñiri, Todos Santos.

Phaethornis pretrei (Lesson and Delattre)

♂ , ♀ ; Rio Lipeo, Bermejo.

Phaethornis subochraceus Todd

o; Rio Quiser (north Chiquitos).

A species very distinct from *pretrei* (cf. Todd, l.c., p. 283).

Phaethornis philippii (Bourcier)

Described from eastern Bolivia.

Phaethornis stuarti Hartert

♀; Rio Surutú, Dept. Santa Cruz.

Phaethornis ruber nigricinctus Lawrence

3 ♂, 6 ♀; Santa Ana, Teoponte, Huanay, Chiñiri, Susi.

Campylopterus largipennis aequatorialis Gould

4 ♂, 5 ♀; Chiñiri, Huanay.

This form is distinguishable from *obscurus* by its less golden-green upper parts, in addition to the lighter gray (not white, as stated by Cory) tips to the outer tail feathers.

Eupetomena macroura subsp.

For a discussion of Bolivian individuals of this hummingbird see Todd (l.c., p. 290). The species is known from Reyes on the Rio Beni (Maxwell), from Chiquitos and Mojos (D'Orbigny) and from the Rio Quiser (Todd).

Florisuga mellivora mellivora (Linnaeus)

6 ♂, 3 ♀; Chatarona, Todos Santos.

Specimens of the Tobago race (*tobagensis* Ridgway) in the collection of the American Museum of Natural History can readily be distinguished from *mellivora* by their decidedly longer bills. The validity of this insular race has lately been questioned (Todd, l.c., p. 291).

Talaphorus hypostictus peruvianus (Simon)

Recorded from Mapiri by Buckley, and from the Cerro del Amboró and Samaipata by Todd.

Patagona gigas gigas (Vieillot)

♀; Oploca (Feb. 28).

This specimen has a wing of 119.5, the exposed culmen 33.5 mm., and very indistinct streaks on the throat. It apparently is referable to the race that breeds in Chile.

Patagona gigas peruviana Boucard

7 ♂, 9 ♀; Vacas, Calacoto, Oploca, Tiraque, Tutimayo, Tanapacá.

Leucippus chionogaster hypoleucus (Gould)

13 ♂, 10 ♀; Sandillani, Calabatea, Arani (near Cochabamba, 7500 ft.), Buenavista, Samaipata, Tomina, Lagunillas, Rio Lipeo, La Merced.

There is considerable variation in length of bill. Two females from La Merced have the exposed culmen 23.5 and 26.5 mm. in length, respectively. The bills of our Bolivian series measure 21.5-24.5 mm. (♂), 23-26.5 (♀). That of a male in the Academy's collection from Tucumán, Argentina, measures 23 mm.

Amazilia bartletti (Gould)

♂, ♀; Chatarona, Chiñiri.

New to Bolivia. These birds agree well with a Peruvian series in the Academy's collection. This hummingbird closely resembles *A. lactea* (Lesson) of southeastern Brazil.

Amazilia versicolor versicolor (Vieillot)

The hummingbird described by Elliot as *Thaumatias neglecta,* from Mojos, Bolivia, is a synonym of *versicolor.*

Amazilia fimbriata nigricauda (Elliot)

4 ♂, 5 ♀; Todos Santos.

These specimens have rather more extensive dusky centers to the under tail-coverts than has a small series from the Rio Tapajoz, Brazil, in this respect resembling typical *fimbriata.*

Hylocharis chrysura chrysura (Shaw)

6 ♂; Villa Montes.

The wings measure 51 to 55.5, bills (exposed culmen) 18.5 to 21.5 mm.

Hylocharis chrysura maxwelli Hartert

♂; Chatarona.

Differs from Villa Montes specimens by its duller, greener tail, and less pronounced gular patch, with the ochraceous coloring obscured by green discs even at the chin. Wing (maximum measurement) 52, exposed culmen 18.5 mm.

Hylocharis cyana rostrata Boucard

♂, ♀; Buenavista.

Hylocharis oenone josephinae (Bourcier and Mulsant)

11 ♂, 2 ♀; Huanay, Calabatea, Santa Ana.

Carriker (Proc. Acad. Nat. Sci., Phila., 87, 1935, pp. 345-346) believed that *oenone* and *josephinae* are not conspecific, and has described *peruviana* from Moyobamba as a northern form of *josephinae.* The type has no purple feathers on the chin and the under tail-coverts indicate that it is not fully adult. We believe that the race *intermedia* Hartert is an unstable intermediate between *oenone* and *josephinae,* as has already been stated by Hartert (Novit. Zool., 5, 1898, pp. 518-519), and that *peruviana* is a synonym of this form.

A male of this species in the Academy's collection from Saposoa, Dept. San Martin, Peru, has the chin and most of the upper throat violet, joined to the violet cap by a rather broad violet band below the eye. The specimen from Moyobamba (type of *peruviana*) has a violet line terminating below the center of the eye and not connecting with the cap posteriorly. The 11 Bolivian males show no trace of a chin spot, and only two show the beginnings of a line passing below the eye.

Our opinion is not based on enough specimens to be conclusive, but perhaps the character that will prove to be most stable in *intermedia* is the extension of the violet below the eye, with the amount of violet on the chin and throat varying from considerable to none. A male from Huacamayo, the most southern of our Peruvian specimens, has the violet suborbital band interrupted, and it is the specimen nearest geographically to *josephinae.*

The female of "*peruviana*", which is not fully adult, has a bill of about the same length as a female from Ecuador, but in color is closer to *josephinae,* having the sides of the body, neck and upper parts less bluish than in *oenone.* The exposed culmen of the various specimens examined of this species measure, in millimeters, as follows.

"Trinidad"; ♂ 20
Cariaquito, Venezuela; ♂ 20 (2)
Boyaca, Colombia; ♂ 18.5, 20, ♀ 22.5
"Colombia"; ♂ 19.5
Voca, Ecuador; ♂ 19.5, ♀ 20.5
Moyobamba, Peru; ♂ 18.5
Saposoa, Peru; ♂ 19.5
Chanchamayo, Peru; ♀ 20
Huacamayo, Peru; ♂ 18, ♀ 18.5
Huanay, Bolivia; ♂ 17.5, 18 (2), 18.5 (3), 19, ♀ 19.
Santa Ana, Bolivia; ♂ 17.5, 18.5, ♀ 19.

It will be noticed that there is a very slight diminution in the length of the bill from north to south. It is so slight, however, that the differentiation of races on this character alone (such as "*longirostris*" from Colombia) would be inadvisable.

Simon gives Peru and Bolivia as the range of *josephinae* and says that some specimens have a small violet spot on the chin. We doubt if this is ever present in Bolivian birds, although evident in many specimens of *intermedia.* Indeed, if the latter intermediate form did not exist, we would without hesitation regard *josephinae* and *oenone* as specifically distinct.

We can find no type locality for *josephinae,* and since it is important that one should be designated, we propose Calabatea, Dept. La Paz, Bolivia. Incidentally, Bourcier and Mulsant in their original description describe a bird with the violet-blue confined to the crown (Rev. Zool., 1846, p. 272).

We might add that *caeruleicapilla* Gould, known from the type without locality in the British Museum and a second specimen in the Simon Collection taken by Garlepp in Santa Cruz, Bolivia, is considered by Salvin as an individual variant of *josephinae* (Cat. Bds. Brit. Mus., 16, 1892, pp. 249-250).

Chlorostilbon aureoventris aureoventris (D'Orbigny and Lafresnaye)

15 ♂, 7 ♀; Lagunillas, Samaipata, Ele-Ele, Todos Santos, Tomina, Rio Lipeo, Bermejo, Villa Montes, La Merced, Fortín Campero, San Lorenzo.

Specimens from southern Bolivia (Dept. Tarija) are slightly smaller than those from Cochabamba as pointed out by Todd (l.c., p. 299). Wing

measurements of the adult males of our Bolivian series are as follows: Dept. Cochabamba (4), 50.5-55.5 mm.; Dept. Santa Cruz (3), 48.5-53.5 mm.; Dept. Tarija (5), 45-49.5 mm.

The males in the Academy's collection from Argentina have wings of 52, 52.5, 56.5 mm.

Chlorostilbon prasinus phaeopygus (Tschudi)

Recorded from Buenavista by Todd (l.c., p. 303).

Chlorostilbon peruanus Gould

♂, ♀; Sandillani.

Thalurania furcata jelskii Taczanowski

16 ♂, 7 ♀; Sandillani, mouth of the Rio Chapare, Chiñiri, Teoponte, Palmar, Huanay, Rio Azero.

There is considerable confusion as to the correct names of the Peruvian and Bolivian forms of this species. We do not agree with Zimmer (Field Mus. Nat. Hist., Zool. Ser., 17, 1930, pp. 295-296) on the use of the name *boliviana* Boucard for birds of southern Peru and Bolivia, since the type of *jelskii* came from Soriano, Junín, and our Bolivian birds agree with examples from Junín. Specimens before us from northern Peru (Moyobamba) agree exactly with descriptions of *tschudii* Gould, the type of which was collected by Hawkswell on the Ucayali River, probably near Sarayacú.

The southern birds (*jelskii*) differ from those from northern Peru (*tschudii*) in having the green of the throat less extensive and terminating abruptly, rather than " melting " into the purple of the breast.

Thalurania furcata baeri Hellmayr

Known from eastern Bolivia.

Thalurania furcata balzani Simon

The type of this form was sent to Simon by Dr. Balzan and was said to have come from the Yungas of Bolivia. However, all our specimens from the Yungas have dark under tail-coverts and are referable to *jelskii*. Hellmayr (Novit. Zool., 14, 1907, p. 78) says of *balzani* that specimens " are at once known by their pure white under tail-coverts." His Bolivian specimens were taken at Salinas and at Reyes on the Rio Beni. Carriker collected a typical specimen of *jelskii* on the Rio Kaka, about 70 miles south of Salinas. It appears obvious that the " Yungas " are an impossible type locality for *balzani* and instead we suggest Reyes on the Rio Beni, whence this race extends northward to the Amazon.

Colibri delphinae (Lesson)

Recorded from Buenavista by Todd (l.c., p. 293).

Colibri cyanotus cyanotus (Bourcier and Mulsant)

Colibri cyanotus crissalis Todd, Ann. Carnegie Mus., 29, 1942, p. 292 (Incachaca, Bolivia).

7 ♂, 2 ♀; Sandillani, Incachaca.

Compared with large series from Venezuela and Colombia, Bolivian birds have on the average more buffy under tail-coverts; however, this is a most variable character.

Of six adult males from Incachaca, the type locality of *crissalis*, three have mostly buff, the remainder mostly green under tail-coverts. Many Colombian specimens examined have the under tail-coverts a rich buff. We thus cannot recognize *crissalis*, which was based solely on this character.

Colibri coruscans (Gould)

14 ♂, 4 ♀; Cochabamba, Sandillani, Tutimayo, Calacoto, Calabatea, Samaipata, Santa Ana, Potosí, Tomina, Incachaca, San Lorenzo.

This is *C. iolatus* (Gould) of authors. Simon believes that "*Pinarolaema buckleyi*" Gould (type from Mizque, Bolivia) is a partially melanistic *coruscans*.

Colibri serrirostris (Vieillot)

9 ♂, 2 ♀; Samaipata, Tomina, Padilla, Sandillani.

We have no Brazilian specimens for comparison.

Anthracothorax nigricollis nigricollis (Vieillot)

5 ♂; Huanay, Chatarona, Todos Santos.

Polytmus guainumbi thaumantias (Linnaeus)

Recorded from Mojos and Buenavista. Todd records 35 specimens from the latter locality and remarks on the great color variation (l.c., p. 317).

Oreotrochilus estella (Lafresnaye and D'Orbigny)

19 ♂, 27 ♀; El Pongo, Oploca, Viloca, Tiraque, Llallagua, Catavi, Calacoto, Càllipampa, Cerro del Juno.

All of the above males have the median abdominal stripe chestnut.

Two nests of this species were found. One that was collected above Lake Lobata, Potosí (15,500 ft.), January 26, is a very bulky cup, composed of moss and hair. It was attached to the face of a cliff. The two eggs measure 16.7 x 10.6, 16.2 x 10.1 mm.

Oreotrochilus leucopleurus Gould

10 ♂, ♀; San Lorenzo.

The above males have the median abdominal stripe black, glossed with violet-blue, and very slightly with green. Otherwise they resemble *estella*. They are precisely like a male in the Academy's collection from Tucumán, Argentina. A male of *stolzmanni* Salvin, from Santa Clara, Dept. Ancash (12,000 ft.), Peru, has the under parts as in *leucopleurus*, but the upper parts are bright metallic green, not brownish gray with a green gloss. The San Lorenzo males have a well-developed black band, separating the green gorget from the white breast. There is considerable variation in the width and shape of the outer rectrices in males of both *estella* and *leucopleurus*.

We can throw no further light on the validity of *bolivianus* Boucard, but we think it likely that it will prove to be a synonym of *leucopleurus* (cf. Berlioz and Rousseau-Decelle, L'Oiseau et Rev. Francaise d'Orn., 3, no. 2, 1933, pp. 343-345; Hellmayr, Birds of Chile, 1932, p. 237; Todd, Ann. Carnegie Mus., 29, 1942, p. 338).

Oreotrochilus adela (D'Orbigny and Lafresnaye)

6 ♂, 9 ♀; Tiraque, Oploca.

It is of interest to note that all the more northern forms of the genus *Oreotrochilus* (*chimborazo, jamesoni, stolzmanni,* and *melanogaster*) have bright metallic green upper parts, whereas the southern species (*estella, leucopleurus,* and *adela*) have the upper surface dull in color.

Lampraster branickii Taczanowski

Two skins of this hummingbird were found by Dr. Thomas Barbour attached to an Indian necklace in a museum at La Paz. These were *supposed* to have come from the Rio Beni. There are no other records from Bolivia (see remarks under *Capito auratus*).

Heliodoxa leadbeateri leadbeateri (Bourcier)

3 ♂, 3 ♀; Calabatea, Palmar.

Todd, who had a large series of this species before him, including specimens from Venezuela (true *leadbeateri*) and Bolivia, considers a southern race ("*otero*" Tschudi) untenable (l.c., p. 336). We have no comparative material.

An immature male from Calabatea has the chin and throat ochraceous, but the feathers on the middle of the throat are violet. The violet crown patch is completely lacking. The under parts are paler and greener than in the adult.

Coeligena volifera volifera (Gould)

15 ♂, ♀; Hichuloma, Incachaca, San Cristobal.

Coeligena inca (Gould)

2 ♀; Incachaca.

We have three males and three females of this beautiful hummingbird from Oconeque, Peru.

Coeligena coeligena boliviana (Gould)

♂; Calabatea.

This bird is much darker than five males of *obscura* (Berlepsch and Stolzmann) from Peru. The latter are nearer *colombiana* Elliot.

Diphogena aurora (Gould)

Known from northern Bolivia. All our six specimens are from Chira, Dept. Cajamarca, Peru.

The green throated species, *D. iris*, is not believed to inhabit Bolivia (cf. Simon, Hist. Nat. Trochil., 1921, p. 364, footnote).

Ensifera ensifera (Boissonneau)

Recorded from Incachaca by Todd (l.c., p. 343).

Pterophanes cyanopterus peruvianus Boucard

6 ♂, 2 ♀; Hichuloma, Incachaca, El Pongo.

Bolivian males (in addition to those from Limbani, Peru) are much greener below than specimens from farther north as stated by Todd (l.c., p. 341). Wing measurements of our fully adult males are as follows: 114 (Hichuloma), 111.5 (El Pongo), 111 and 113 (Limbani, Peru), 114 (Cajamarquilla, Peru), 108 (Pinchincha, Ecuador). A nearly adult male (*cyanopterus*) from the Nevado de Tolima, Central Andes of Colombia, has a wing of 100 mm.

Aglaeactis pamela (D'Orbigny and Lafresnaye)

15 ♂, 8 ♀; Hichuloma, near Viloca, Incachaca, Chorros.

We have no specimens of the Peruvian *castelnaudii* for comparison.

Vestipedes glaucopoides (D'Orbigny and Lafresnaye)

3 ♂, 2 ♀, o; Incachaca, 25 km. east of Padilla.

A specimen, labelled as an immature male, resembles the females, which lack the violet forehead and have the anterior under parts and middle of the breast ochraceous-cinnamon.

Vestipedes aureliae assimilis (Elliot)

3 ♀; Sandillani.

This hummingbird is sometimes placed in the genus *Haplophaedia*. The above specimens agree with Peruvian females in the Academy's collection, taken at Santo Domingo (Inca Mine) and at Oconeque.

Ocreatus addae (Bourcier)

2 ♂, 2 ♀; Calabatea.

We follow Todd in using the name *addae* for this species, rather than *rufocaligatus* Gould (l.c., p. 347).

Adelomyia inornata (Gould)

10 ♂, 11 ♀, 2 o; Calabatea, Sandillani, Incachaca, San Jacinto, Palmar, "Yungas of Cochabamba", Samaipata, Rio Azero, Rio Lipeo.

A single female from the Rio Lipeo (Dept. Tarija) is more ochraceous on the posterior under parts than most individuals from farther north, but can be matched in this respect by a female from Calabatea (Dept. La Paz). Sandillani specimens are topotypes.

We also have specimens of this species from Santo Domingo (Inca Mine) and Oconeque, southeast Peru.

Heliangelus amethysticollis amethysticollis (D'Orbigny and Lafresnaye)

2 ♂, 2 ♀; Hichuloma, Sandillani, Incachaca.

We agree with Carriker (Proc. Acad. Nat. Sci., Phila., 87, 1935, pp. 346-347) that *laticlavius* Salvin is intermediate between *amethysticollis* and *clarissae* (Longuemare) and that the three forms should be regarded as conspecific.

Two specimens in the Academy's collection from Oconeque, southeast Peru, are *amethysticollis*, while a male from Huacapistana, Junín, in central Peru, is referable to *laticlavius*.

Metallura phoebe (Delattre and Lesson)

Recorded from western Bolivia.

Metallura aeneocauda (Gould)

8 ♂, ♀; Hichuloma.

Metallura malagae (Berlepsch)

2 ♂, ♀; Incachaca.

In comparison with adult males the female has the under parts more buffy, the green gorget less extensive, and the outer rectrices tipped with grayish buff. In addition, it is decidedly smaller. ♂: wing (maximum measurement) 64.5-65.5, tail 42.5-44; bill (exposed culmen) 20.5-21 mm. ♀: wing 57.5, tail 38, bill 19 mm. Males of *aeneocauda* have a wing of 64-66, tail 39-44, bill 18-19 mm.

This species is closely related to *aeneocauda,* but differs in having a longer bill and reddish bronze, rather than greenish bronze, tail. The difference in the color of the tail is particularly evident when viewed from below.

Metallura tyrianthina smaragdinicollis (Lafresnaye and D'Orbigny)

17 ♂, 12 ♀; Hichuloma, Tanapacá, Incachaca, Chorros.

For an elucidation of the range of this species see Carriker (Proc. Acad. Nat. Sci., Phila., 87, 1935, p. 347).

Chalcostigma stanleyi vulcani (Gould)

♂, ♀; Hichuloma, km. 50 Yungas Railroad.

In addition to the above specimens, the Academy has a male and two females from Limbani, southeast Peru.

Chalcostigma olivaceum olivaceum (Lawrence)

3 ♂, 4 ♀; km. 34 Yungas Railroad, La Cumbre, Viloca, El Pongo.

We have further specimens from Aricoma and Huancarani, Peru.

Chalcostigma ruficeps ruficeps (Gould)

2 ♂, 3 ♀; Sandillani, San Jacinto, San Cristobal, Incachaca.

Two males of this hummingbird from Oconeque, southeast Peru, appear indistinguishable from Bolivian examples.

Aglaiocercus kingii smaragdinus (Gould)

15 ♂, 4 ♀, o; Sandillani, Incachaca, "Yungas of Cochabamba."

We follow Zimmer (Field Mus. Nat. Hist., Zool. Ser., 17, 1930, p. 290) in treating *smaragdinus* as a subspecies of *kingii*.

Sappho sapho (Lesson)

37 ♂, 15 ♀; Cochabamba, Tiraque, Tutimayo, Potosí, Oploca, Padilla, 25 km. east of Padilla, Tomina, San Lorenzo, Bermejo, Entre Rios.

Sappho sparganura (Shaw)

5 ♂, 2 ♀; Calacoto.

Closely related to, and perhaps better regarded as conspecific with *sapho*.

Lesbia nuna nuna (Lesson)

Recorded from northwestern Bolivia.

Lesbia nuna boliviana (Boucard)

A little-known race from Bolivia. We know of no definite localities whence this bird has been collected. For a discussion of the forms of *L. nuna* see Zimmer (Field Mus. Nat. Hist., Zool. Ser., 17, 1930, pp. 284-285).

Schistes geoffroyi bolivianus Simon

This hummingbird was recently recorded from San José, north of Incachaca (Todd, l.c., p. 354).

Heliothryx aurita auriculata (Nordmann)

♂; Chiñiri.

A specimen of this hummingbird was recently recorded from Buenavista by Todd (l.c., p. 355). The Chiñiri example is apparently the second individual of *Heliothryx* that has been collected in Bolivia.

Heliomaster furcifer (Shaw)

11 ♂, 5 ♀; Ele-Ele, Bermejo, Villa Montes.

Heliomaster longirostris longirostris (Audebert and Vieillot)

Anthoscenus longirostris caeruleiceps Bond and de Schauensee, Not. Naturae, no. 93, 1941, p. 3 (Huanay, Rio Mapiri, Bolivia).

7 ♂, 3 ♀; Huanay, Todos Santos.

After comparison with additional specimens of *longirostris* from Trinidad (the type locality) and Venezuela, we agree with Todd (l.c., p. 356) that a Bolivian race of this species is not valid. There is great individual variation throughout the range of *longirostris*.

Myrtis yarrelli (Bourcier)

Recorded from western Bolivia.

Calliphlox amethystina (Gmelin)

♂, 4 ♀; Huanay.

Acestrura mulsanti (Bourcier)

8 ♂, 5 ♀; Incachaca, "Yungas of Cochabamba."

Microstilbon burmeisteri (Sclater)

3 ♂, 4 ♀; Tomina, 26 km. east of Padilla, Padilla, Bermejo, Entre Rios.

Todd, who had 35 specimens from Buenavista, has discussed this interesting species at length (l.c., p. 358).

Klais guimeti pallidiventris (Sztolcman)

(Ann. Zool. Mus. Polon. Hist. Nat., 5, 1926, p. 213 (Peru).

2 ♂, 2 ♀; Palmar, Chiñiri.

Six males from Peru and Bolivia have the throat more purple, less violet, and the abdomen more extensively whitish than four from Venezuela (*guimeti*). Females from Colombia and Venezuela appear indistinguishable from Peruvian and Bolivian examples.

We wish to thank Mr. John T. Zimmer of the American Museum of Natural History for the loan of specimens from Colombia and Venezuela.

Lophornis delattrei (Lesson)

3 ♂, 6 ♀; Calabatea, Chiñiri, Todos Santos.

This is *L. regulus* (Gould) of authors.

Lophornis verreauxi verreauxi (Bourcier)

♀; Todos Santos.

New to the fauna of Bolivia.

Popelairia letitiae (Bourcier and Mulsant)

Known only from "Bolivia."

Family **TROGONIDAE** (Trogons)

Pharomachrus auriceps auriceps (Gould)

3 ♂, ♀; Incachaca.

The males have wings of 187, 194, 205 mm. That of the female measures 210 mm. The males have the pileum averaging more golden-bronze than in a series from Colombia, Ecuador, and Peru.

Pharomachrus antisiensis (D'Orbigny)

♂, 2 ♀; Samaipata.

Trogon melanurus melanurus Swainson

5 ♂, ♀; Mouth of the Rio Chapare, Todos Santos, Chiñiri.

Compared with British Guiana specimens from which they do not differ.

Trogon collaris collaris Vieillot

3 ♂, 5 ♀; Chatarona, Santa Ana, Susi.

Trogon personatus submontanus Todd

Trogon temperatus submontanus Todd, Proc. Biol. Soc. Wash., 56, 1943, p. 8 (Samaipata).

16 ♂, 7 ♀; Samaipata, San Jacinto, Sandillani, Santa Ana, Incachaca, San Cristobal, Palmar.

We consider this bird a connecting link between *personatus* Gould and *temperatus* Chapman. In comparison with Colombian specimens and three Peruvian males of *temperatus* from Leymebamba, Dept. Amazonas and Chira (7500 ft.), Dept. Cajamarca, Bolivian birds have decidedly larger bills but are otherwise virtually similar.

Our Bolivian specimens of this species were collected between 2600 and 8900 feet. The single male taken at Palmar (2600 ft.) is unfortunately immature.

Trogon curucui behni Gould

4 ♂, 5 ♀; Rio Lipeo, Bermejo, Villa Montes, Lagunillas.

Wing measurements are as follows: ♂ 131, 133, 138 mm.; ♀ 131.5, 133, 134.5, 135 mm.

Males in the Academy's collection from Descalvados, Matto Grosso, Brazil, have wings of 121, 122.5, and 127 mm.; those of females measure 124.5, 127.5 mm. These are presumably referable to the "Campo" form (= *curucui*) of southern Brazil, and cannot be referred to *behni* as was done by Naumburg (Bull. Amer. Mus. Nat. Hist., 60, 1930, p. 161). In color Matto Grosso males are very different from *bolivianus* as pointed out by Chapman (idem, 36, 1917, p. 316), resembling *behni*, but with the white pectoral zone less pronounced or absent.

Trogon curucui bolivianus Ogilvie-Grant

7 ♂, 8 ♀; Santa Ana, Todos Santos, Chiñiri, junction of the Rio Chapare and Rio Chimoré, Calabatea.

Wing measurements are as follows: ♂, 122.5, 123, 123.5, 124.5, 125, 125.5, 127.5, 128; ♀, 121, 124, 125, 127.5, 128, 129.5 mm.

This series agrees both in color and size with specimens from La Oroya, Shapaja, Moyobamba, and Huacamayo.

Trogon strigilatus strigilatus (Linnaeus)

A wide ranging species, which has been recorded from Bolivia.

Family **ALCEDINIDAE** (Kingfishers)

Megaceryle torquata torquata (Linnaeus)

3 ♂, ♀; Chatarona, Susi, La Merced, Rio Lipeo.

A male from La Merced, Dept. Tarija, has the exposed culmen 77 mm. Hellmayr states that the bill of *stellata* (Meyer) "barely exceeds 70 mm. in length. He refers south Bolivian birds as well as those from Tucumán, Argentina, to the nominate form (Birds of Chile, 1932, p. 254).

Chloroceryle amazona amazona (Latham)

Recorded from Chiquitos, San Luís, and from the lower Rio Beni.

Chloroceryle americana mathewsii Laubmann

2 ♂, 2 ♀; Susi, Entre Rios.

A male from Susi is smaller (wing 79.5 mm.) than those from southern Bolivia and thus approaches *americana*. However, the bird is decidedly greener than the nominate race, or *cabanisi* (Tschudi) from Peru. Wings of the specimens from Entre Rios measure: ♂ 83, ♀ 81.25, 84 mm.

Chloroceryle inda (Linnaeus)

♂, 2 ♀; Chatarona, Susi, mouth of the Rio Chapare.

Chloroceryle aenea aenea (Pallas)

Recorded from the lower Rio Beni.

Family **MOMOTIDAE** (Motmots)

Urospatha martii olivacea Cory

♂; Calabatea.

New to Bolivia. This specimen agrees well with a male from Huacamayo with the exception of its somewhat longer bill (42 v. 38 mm.).

Electron platyrhynchus medianum Todd

♂; Todos Santos.

Compared with Peruvian specimens of *E. p. pyrrholaemus* (Berlepsch and Stolzman), including a topotype, our bird differs by having the pileum and hind neck a deeper chestnut. Other characters ascribed to this race by Todd are not apparent in our specimen.

Momotus momota nattereri (Sclater)

3 ♂, 3 ♀; mouth of the Rio Chapare, junction of the Rio Chapare and Rio Chimore, Todos Santos, Susi, Chatarona, Santa Ana, Santa Cruz (D'Orbigny specimen).

Momotus momota pilcomajensis Reichenow

6 ♂, 6 ♀; Rio Lipeo, Lagunillas, Rio Azero, Fortín Campero, Villa Montes.

A race differing from *nattereri* Sclater by its much greener under parts.

Baryphthengus ruficapillus (Vieillot)

Recorded from southeastern Bolivia (El Hornero, 7, 1938, p. 91).

Family **GALBULIDAE** (Jacamars)

Galbula rufo-viridis heterogyna Todd

6 ♂, 4 ♀; Junction of Rio Chapare and Rio Chimoré, Chatarona, mouth of the Rio Chapare, Todos Santos, Chiñiri.

As Todd has stated in his description of *heterogyna,* the females differ markedly from the males in the color of the under parts. The posterior under parts are buffy ochraceous rather than pale rufous as in the nominate form and the throat likewise is decidedly paler. A series (6 ♂, 2 ♀) from Descalvados, Matto Grosso, Brazil, resembles our Bolivian birds and thus should be referred to *heterogyna.*

Urogalba dea amazonum (=*phainopepla* Todd) and the puff-bird, *Notharchus tectus picatus*, are recorded by Cory from Porto Velho, Bolivia (Bds. Amer., 2, pt. 2, 1919, p. 382 and p. 394). We believe the above locality to be on the upper Rio Madeira in Brazil.

Brachygalba lugubris melanosterna Sclater

Recorded from eastern Bolivia (Cat. Bds. Brit. Mus., 19, p. 174).

Family **BUCCONIDAE** (Puff-birds)

Notharchus macrorhynchos hyperrhynchus (Sclater)

Recorded from Buenavista, Santa Cruz, by Todd. (Ann. Carnegie Mus., 30, art. 1, 1943, p. 1.)

Argicus macrodactylus (Spix)

Three examples from southeastern Peru (Huacamayo, Sandia) in the collection of the Academy, and one from Bolivia (Todos Santos, Rio Chapare) in the collection of the American Museum of Natural History, average decidedly paler than those from northern South America. The species is, however, extremely variable in color. Some Colombian specimens are virtually indistinguishable from our south Peruvian examples, but all those seen from Ecuador have the pileum decidedly darker brown. A specimen in the Academy's collection from central Peru (Puerto Yessup, Junín) likewise has a dark brown pileum but in other respects resembles south Peruvian birds. Chapman states (Bull. Amer. Mus. Nat. Hist., 55, 1926, p. 356) that he "cannot separate Peruvian from lower Orinocan specimens (*A. m. caurensis* Cherrie)." We think it likely, however, that a review of the species, based on adequate material from all parts of its range, will show that more than one form is recognizable.

Nystalus maculatus striatipectus (Sclater)

5 ♂, 7 ♀; Samaipata, Villa Montes, Entre Rios, Ele-Ele, Lagunillas, Fortín Campero.

Nystalus chacuru uncirostris Sztolcman

4 ♂, 3 ♀; Chatarona, Samaipata.

A female from Samaipata, in very worn plumage, has the under parts slightly tinged with ochraceous-buff. Chatarona birds in equally worn plumage are almost white below. The Samaipata bird was taken at the end of November, those from Chatarona toward the end of September. It is possible that birds from extreme eastern Bolivia should be referred to the nominate race, the type locality of which is Paraguay. Laubmann records specimens from Buenavista and Monte Grande (Santa Cruz) as *uncirostris*.

Nystalus striolatus striolatus (Pelzeln)

2 ♀; Calabatea, Santa Ana.

A female from Huacamayo, Sandia, Peru, is indistinguishable from the two Bolivian specimens. A distinct race (*N. s. torridus* Bond and de Schauensee) was recently described from the lower Amazon (Not. Naturae, no. 50, 1940, p. 1).

Malacoptila fulvogularis fulvogularis Sclater

♀; Calabatea.

This specimen is larger than 13 Peruvian examples. The wing measures 102 mm. as compared with 94-99.5 mm. (9 Peruvian females). The ochraceous on the chest is more restricted and paler than in three males and three females of *melanopogon* Berlepsch and Stolzmann from the Departments of San Martin (Rio Jelashte), Cajamarca (Tamborapa), and Junín (Pichis Trail, km. 93). Birds from La Oroya (Inambari), and Santo Domingo (Inca Mine) are more or less intermediate.

Monasa morphoeus peruana Sclater

Monasa morpheus (sic) *bolivianus* Carriker, Proc. Acad. Nat. Sci. Phila., 87, 1935, p. 320 (Susi, Rio Beni, Bolivia).

2 ♂; Susi, Santa Ana.

We find no character by which *M. m. bolivianus* Carriker can be distinguished from *peruana*.

Monasa nigrifrons canescens Todd

♂, 5 ♀; Todos Santos, Chiñiri.

Family **CAPITONIDAE** (Barbets)

Capito niger bolivianus Ridgway

The type of this race was found by Dr. Thomas Barbour in a museum at La Paz, Bolivia, attached to an Indian necklace. It was believed to have come from the Rio Beni, which was named as the type locality. We suggest that the bird may have been taken on the lower Rio Beni, at or below

Reyes, since the form from the upper Beni proves to be *insperatus* Cherrie. A decided faunal break occurs along this river in the vicinity of Reyes. *C. n. bolivianus* is said to have the crown "antique brown with an old gold tint" and "a trace of an orange abdominal band" (Chapman, U. S. Nat. Mus., Bull. no. 117, 1921, p. 74).

Incidentally, attached to the necklace on which was found this barbet, were two specimens of *Lampraster branickii,* a hummingbird known definitely only from Peru.

Capito niger insperatus Cherrie

3 ♂ ; Susi, Todos Santos.

A Rio Beni male resembles very closely examples from Todos Santos, which are virtual topotypes of *insperatus* Cherrie. The crown is sulphur-yellow, even brighter and more uniform than in the Rio Chapare birds, and the breast is more golden, less olive-yellow. Similar variation is evident in a series of this species from Moyobamba, Peru.

The color variations are of great interest. Chapman in his review of *Capito auratus* (Amer. Mus. Novit., no. 335, 1928, pp. 1-21) unfortunately failed to include *niger,* which bird we feel is an important link in the problem. Clearly all the forms grouped under *auratus* should be considered subspecies of the scarlet throated *niger* of the Guianas, which in addition, has a red forehead.

Capito versicolor Müller

8 ♂, 6 ♀ ; Sandillani, Calabatea, Incachaca, San Jacinto, Palmar, Santa Ana, "Yungas of Cochabamba."

Family **RAMPHASTIDAE** (Toucans)

Ramphastos toco toco Müller

3 ♂, 3 ♀ ; Chatarona, Lagunillas, Rio Lipeo.

We follow Griscom and Greenway (Bull. Mus. Comp. Zool., 88, no. 3, 1941, pp. 194-5) in referring Bolivian birds to the nominate form. One specimen from southern Bolivia (Dept. Tarija) has the throat strongly washed with yellow. On the other hand a male from Lagunillas and a female from Chatarona have white throats. The bills of Bolivian specimens are larger than in specimens from Paraguay and Goyaz, which are referable to *albogularis* Cabanis.

Ramphastos tucanus cuvieri Wagler

5 ♂, ♀ ; Rio Surutú, Chiñiri, Todos Santos, mouth of the Rio Chapare, Huanay.

For remarks on the forms of this species see Griscom and Greenway (Bull. Mus. Comp. Zool., 81, 1937, pp. 427-430).

Ramphastos culminatus Gould

♂, 2 ♀ ; Yungas of Cochabamba, Chatarona, Calabatea.

Andigena cucullatus (Gould)

2 ♂, 2 ♀; Incachaca, San Cristobal.

Pteroglossus castanotis australis Cassin

3 ♂, 4 ♀; Santa Ana, Todos Santos, Buenavista.

Aulacorhynchus derbianus derbianus (Gould)

6 ♂, 4 ♀; Calabatea, Palmar.

Aulacorhynchus caeruleocinctus D'Orbigny

7 ♂, 6 ♀; Incachaca, San Jacinto, Sandillani, San Cristobal, Samaipata.

We feel that the validity of *A. c. borealis* Carriker, from the department of Junín, Peru (Proc. Acad. Nat. Sci. Phila., 85, 1933, p. 5), remains to be proved by the taking of further specimens. All three examples of "*borealis*" have a certain amount of chestnut on the pair of rectrices next to the middle ones. A Bolivian male from San Cristobal has these feathers broadly chestnut on both webs, while others from Bolivia have either no chestnut (the majority) or a varying amount of this color.

Family PICIDAE (Woodpeckers and Piculets)

Colaptes campestris campestris (Vieillot)

♂, 2 ♀; Chatarona, Buenavista.

A set of four fresh eggs was collected at Susi, September 15. The eggs measure 31.5 x 21.9, 31.1 x 22.3, 30.6 x 22.5, 30.1 x 21.5 mm.

Colaptes rupicola rupicola D'Orbigny

9 ♂, 9 ♀; Padilla, Kari-Kari Mts., Tiraque, Oploca, Llallagua, La Cumbre, Callipampa, Chorros, "Bolivia."

A single female from La Cumbre has a longer and more slender bill than the rest of the series.

Hypoxanthus atriceps Sclater and Salvin

5 ♂, 5 ♀; Sandillani, Incachaca.

The squamations on the breast vary considerably in the above specimens.

Tripsurus cruentatus extensus Todd

Ann. Carnegie Mus., 25, 1937, p. 251 (Rio Purús, Brazil).

5 ♂, 3 ♀; Rio Surutú, Todos Santos, Santa Ana.

These birds differ from three specimens from French Guiana by having the abdominal patch more extensive and of a deeper red, characters given in the original description of *extensus*.

Leuconerpes candidus (Otto)

6 ♂, 4 ♀; Ele-Ele, Tomina, Buenavista.

Three of the males have a conspicuous yellow patch on the breast. The remaining three show no trace of this.

Piculus chrysochloros chrysochloros (Vieillot)

♂ ; Fortín Campero.

The iris is recorded as " pale blue." The specimens of the following two species of this genus had " brown " irides.

Piculus rubiginosus canipileus (D'Orbigny)

4 ♂, 3 ♀ ; Calabatea, Palmar, San Jacinto.

Piculus rubiginosus tucumanus (Cabanis)

14 ♂, 7 ♀ ; Rio Lipeo, Rio Azero, Padilla, La Merced, Entre Rios, Villa Montes, Ele-Ele, Samaipata.

The range of this form, hitherto known only from northern Argentina, extends northward into southern Cochabamba (Ele-Ele and Santa Cruz). Birds from the latter localities are indistinguishable from a series from the Bolivian-Argentine border, and show no approach to the more northern *canipileus*.

Piculus leucolaemus australis (Carriker)

Chloronerpes leucolaemus australis Carriker, Proc. Acad. Nat. Sci. Phila., 87, 1935, p. 318 (Santa Ana, 2200 ft., Rio Coroico, Bolivia).

3 ♂, ♀ ; Santa Ana, mouth of the Rio Chapare.

Chrysoptilus melanolaimus melanolaimus (Malherbe)

9 ♂, 9 ♀ ; Oploca, San Cristobal, Chorros, Ele-Ele, San Lorenzo.

We consider all these birds to be referable to the nominate form, which is very variable, particularly as to the color of the throat and spotting of the under parts. One male from Oploca has the entire chin and throat with no white streaks. We would also include under *melanolaimus* specimens from Salta, northwestern Argentina, whence we have examined three males and six females. Tucumán birds are strikingly different and are presumably referable to *leucofrenatus* Leybold, of Mendoza, western Argentina. These have the throat much more narrowly streaked than birds from farther north, and there is an admixture of white on the malar stripes of the females. Two males and five females from Tucumán have been compared with our Bolivian series.

Chrysoptilus melanochlorus nattereri (Malherbe)

Recorded from Buenavista, Dept. Santa Cruz (Hellmayr, Field Mus. Nat. Hist., Zool. Ser., 12, no. 18, 1929, p. 411).

Celeus lugubris lugubris (Malherbe)

Recorded from eastern Bolivia (Dept. Santa Cruz).

Celeus jumana saturata Carriker

Proc. Acad. Nat. Sci. Phila., 87, 1935, p. 318 (Chatarona, Dept. Beni, Bolivia).

♂, ♀ ; Chatarona.

This bird is similar in color and in size to *citreopygius,* but has the inner webs of the remiges barred as in *jumana.* The type does not appear fully adult.

Celeus spectabilis exsul Bond and de Schauensee

Not. Naturae, no. 93, 1941, p. 4 (Todos Santos, 1000 ft., Rio Chapare, Dept. Cochabamba, Bolivia).

♂, ♀; Todos Santos, Susi.

This species was known hitherto only from Ecuador.

Crocomorphus flavus peruvianus Cory

2 ♂; Todos Santos, mouth of Rio Chapare.

A fully adult male is less bright yellow than adult Peruvian specimens, and further differs by having the wing-coverts very narrowly edged rather than heavily margined with yellowish as in *peruvianus.* With more material Bolivian birds may prove separable. The genus *Crocomorphus* has not previously been recorded from this republic.

Ceophloeus lineatus lineatus (Linnaeus)

4 ♂, 4 ♀; Santa Ana, Calabatea, Todos Santos, Chatarona, Rio Surutú, Villa Montes.

A male (A. N. S. P. no. 143343), taken at Villa Montes in extreme southern Bolivia, is in a most interesting phase of plumage. Except for its dark bill and larger size it is virtually indistinguishable from "*Neophloeotomus schulzi*" of northern Argentina. The melanism has progressed to such an extent that the entire under surface, with the exception of the flanks, are black as is the entire back. There is no trace of the white bands formed by the scapulars. The under wing-coverts are pale sulphur-yellow, with a large blotch of black near the bend of the wing. We feel it significant to find a melanism of *C. lineatus* so near the range of "*Neophloeotomus schulzi*" the plumage of which, as has been shown by Devilli (El Hornero, 4, 1931, p. 415), is most variable. We think that "*Neophloeotomus*" merely represents a melanism of *C. lineatus* as believed by Pergolani (El Hornero, 8, no. 1, 1941, pp. 3-6). It differs, however, from *C. l. lineatus* in having a pale and shorter bill like that of *C. l. similis* (Lesson). Our melanistic specimen has a wing of 189 mm. and tail of 128 mm. Unfortunately, the tip of the bill is broken.

The relationship of "*Neophloeotomus schulzi*" and of *Ceophloeus erythrops* to *Ceophloeus lineatus* is very puzzling and we leave the problem to Argentine ornithologists who have an opportunity of studying these birds in the field.

Carriker also secured a normally colored *lineatus* at Villa Montes. This and other normally colored Bolivian specimens of *Ceophloeus* have the following wing measurements: ♂ 190, 192, 196; ♀ 190, 192, 192, 183.5 mm. (wings measured flat against the ruler).

Phloeoceastes leucopogon (Valenciennes)

We have a male (D'Orbigny Collection) labelled as having been taken at " Valle Grande," and, in addition, a male and female from Puerto Casado, Paraguay.

Phloeoceastes rubricollis trachelopyrus (Malherbe)

6 ♂, 7 ♀; San Jacinto, Palmar, Todos Santos, Chiñiri, Santa Ana, Samaipata.

Phloeoceastes melanoleucos melanoleucos (Gmelin)

2 ♂, ♀, o; Rio Azero.

The specimens have wings measuring (♂) 193, 186, (♀) 185, (o) 193, within the range of measurements as given for the nominate form. A male from Moyobamba, Peru, has a wing of 197, those of females from this locality 188, 191, 193.5 mm.

Veniliornis fumigatus fumigatus (D'Orbigny and Lefresnaye)

2 ♂, 2 ♀, o; Incachaca, Samaipata, Sandillani.

Veniliornis nigriceps nigriceps (Lafresnaye and D'Orbigny)

9 ♂, 7 ♀; Incachaca, Sandillani, San Cristobal, Hichuloma.

A specimen from Hichuloma, marked definitely as a female, has the pileum scarlet, a well-known character in some immature male woodpeckers. An unquestionably adult female from the same locality has the pileum entirely black and is indistinguishable from specimens of the same sex from other Bolivian localities.

Veniliornis passerinus olivinus (Malherbe)

♂, ♀; Todos Santos.

These two birds agree with a series from Descalvados, Matto Grosso, Brazil. They are decidedly greener below than specimens of *V. p. agilis* from Peru and northern Bolivia, and lack the white malar stripe and superciliary.

Veniliornis passerinus agilis (Cabanis and Heine)

4 ♂, 2 ♀; Chatarona, Susi, Chiñiri.

These specimens agree with a small series from Peru. The race has not previously been recorded from Bolivia.

Veniliornis frontalis (Cabanis)

11 ♂, 11 ♀, o; Rio Lipeo, Samaipata, Todos Santos, Entre Rios, Bermejo, Villa Montes, Rio Azero, La Merced, Lagunillas.

Although closely related to *V. passerinus* this form is specifically distinct, since Zimmer records specimens of *V. frontalis* and *V. p. olivinus* from

"Vermejo, Prov. Santa Cruz" (Amer. Mus. Novit., no. 1159, 1942, p. 1) and Carriker obtained these two species at Todos Santos.

Veniliornis affinis hilaris (Cabanis and Heine)

4 ♂, 4 ♀; Santa Ana, Palmar, Teoponte, Todos Santos, mouth of the Rio Chapare.

Although the bills of Bolivian birds are slightly larger than those of specimens from Peru, we do not feel justified in describing a new race on such a trifling difference. The exposed culmen of Bolivian males measures 22, 23.5, 24, 24.5, of Peruvian males 19.5 (2), 20 (2), 21 (2), of Bolivian females 21, 22, 23, of Peruvian females 18, 20, 21.5 mm.

Dyctiopicus mixtus malleator Wetmore

Jour. Wash. Acad. Sci., 12, 1922, p. 326 (Las Palmas, Argentine Chaco).

Recorded from Villa Montes.

Dyctiopicus lignarius (Molina)

9 ♂, 8 ♀; Oploca, La Merced, Tomina, Ele-Ele, Comarapa (Dept. Santa Cruz); Aiguile (Dept. Cochabamba).

A single male from Chile in the Academy's collection has the crown much less heavily streaked with white than has any of our Bolivian birds, although Hellmayr states of the Bolivian "*D. puncticeps*" D'Orbigny.—"The types which I have carefully compared in the Paris Museum appear to be inseparable from Chilean birds" (Field Mus. Nat. Hist., Zool. Ser., 19, 1932, p. 152).

Picumnus grandis Carriker

Proc. Acad. Nat. Sci. Phila., 87, 1930, p. 367 (Puerto Yessup, Junín, Peru).

2 ♂, 3 ♀; Todos Santos.

An excellent species, most closely related to *P. rufiventris* (Bonaparte). In color the males differ from those of *rufiventris* in numerous respects but chiefly in having the posterior rather than the anterior portion of the pileum spotted with red. The forehead and fore part of the crown are minutely speckled with white, instead of being streaked with red as in *rufiventris*. The toes in *grandis* are proportionately very long.

Picumnus cirratus d'orbignyanus Lafresnaye

4 ♂, 6 ♀, o; Rio Azero, Ele-Ele, Samaipata, Tomina, "Inquisili"=Inquisivi.

An unsexed specimen from Inquisivi, undoubtedly a female, must be the type of *d'orbignyanus*. The example was collected by D'Orbigny and is part of the Rivoli-Massena Collection (cf. Rev. Zool., 1845, pp. 7-8).

We regard *d'orbignyanus* as well as the Peruvian *jelskii* as conspecific with *cirratus*.

Picumnus cirratus thamnophiloides Bond and de Schauensee Not. Naturae, no. 105, 1942, p. 1 (Bermejo, Dept. Tarija, Bolivia).

9 ♂, 8 ♀; Rio Lipeo, La Merced, Entre Rios, Bermejo.

A form connecting *P. cirratus* with *P. d'orbignyanus.*

Picumnus cirratus subsp.

♂, 4 ♀; Villa Montes.

These specimens resemble closely those taken by Wetmore at Formosa, Argentina, and at Puerto Pinasco, Paraguay (U. S. Nat. Mus., Bull. 133, 1926, pp. 210-212). The black barring on the under parts is more or less broken, particularly on the chest, and the chin and throat are immaculate. Skins from Las Palmas and Resistencia in the Argentine Chaco, as well as a specimen in the Academy's collection labelled " Chaco, Argentina " and examples from Tucumán in the collection of the American Museum of Natural History, have the under parts, including the throat, regularly barred and, as Wetmore has stated, represent a different race. In the original description of *pilcomayensis,* Hargitt stated that his type is " clearly barred with black upon the whole of the under parts," which would apply to the more southern birds. He merely assumed that the type came from the Rio Pilcomayo, since no label accompanied the specimen. In all probability it was collected farther south on the Rio Paraná (l.c., p. 211). The problem can not be settled definitely until the type is reexamined.

We are indebted to Dr. Wetmore for his kindness in sending us for examination his specimens from Argentina and Paraguay.

Picumnus albosquamatus albosquamatus Lafresnaye

4 ♂, 8 ♀; Chatarona, mouth of the Rio Chapare, Samaipata, Sandillani.

We see no reason to retain *P. guttifer* Sundevall as a species distinct from *albosquamatus.* Our series of *albosquamatus* shows considerable variation. A female has the under parts dirty white, the feathers edged with blackish, whereas another female has the feathers of the throat and breast pure white, edged with blackish, while the feathers of the breast are centered with black as in *guttifer.*

A COLLECTION OF FRESH-WATER FISHES FROM COLOMBIA, OBTAINED CHIEFLY BY BROTHER NICÉFORO MARIA

by Henry W. Fowler

Curator of Fishes, The Academy of Natural Sciences of Philadelphia

The collections of freshwater fishes sent to us in 1931 and 1932 by Brother Nicéforo Maria, of the Museo del Instituto de La Sallé, Bogotá, are represented by 388 specimens which I identify as 68 species. Of these 21 are described and figured as new, also one new genus and one new subgenus.

These collections are also represented from the Magdalena, Orinoco and Amazon watersheds. Those from the last named drainage area are, I believe, among the first to be reported from Colombia, where they were secured at Florencia from the Rio Orteguasa basin in the district of Caquetá. In the Magdalena the localities are Honda, Gualanday, Muzo, Medellín, San Gil, Fusagasugá, Jericó, and Sonsón. In the Orinoco the localities are Villavicencio, Choachi, Guaicaramo, Rio Ocoá south of Villavicencio, and the Rio Guayuriba.

The Academy is indebted to Brother Nicéforo Maria for the gift of this valuable collection, with finely prepared specimens, as a most important accession. In listing the known species references are given only to those not noticed in my previous papers on South American fishes, or to the several demanding more critical adjustment.

SYNBRANCHIDAE

Synbranchus marmoratus Bloch

One, 175 mm., Villavicencio, Meta River, 1931. Brown, marbled or vermiculated with darker.

CHARACIDAE

CURIMATINAE

Curimata metae Eigenmann

Curimatus metae Eigenmann, Mem. Carnegie Mus., vol. 9, no. 1, Oct. 1922, p. 230, pl. 17, fig. 1 (photographs) (type locality, Quebrada Cramalote, Villavicencio, Colombia).

Depth $3\frac{1}{5}$; head $3\frac{3}{4}$. Scales 32 + 2 in lateral line; 6 above to dorsal origin, 5 below to ventral origin, 5 below to anal origin, 12 predorsal. D. III, 9; A. III, 7. No dark spot on dorsal. Black basal caudal blotch, reflected forward as underlaid band, fading out below dorsal and continued

backward embraces all of median caudal rays back to their tips. Lower caudal lobe marked with blackish dots and producing a dark appearance.

One, 95 mm. to end of broken caudal, Villavicencio, 1931.

Curimata niceforoi new species — Figures I (head above), 2 (head below), and 3.

Depth $3\frac{1}{8}$, predorsal largely rounded anteriorly, only with slight ridge close before dorsal fin; belly with preventral and postventral surfaces evenly rounded or convex; head $3\frac{1}{4}$, width $1\frac{7}{8}$ in its length. Snout (in profile) $3\frac{1}{4}$ in head; eye slightly longer than snout or $3\frac{1}{8}$ in head, $1\frac{2}{3}$ in interorbital, with broad adipose lid all around; mouth small, inferior, with short cleft reaching opposite hind nostril, width equals snout length; no teeth; interorbital $2\frac{2}{3}$ in head, broadly convex; suborbitals cover cheek, in contact with preopercle ridge; supra-occipital extension short, bordered with 2 full scales along each side. Gill opening large, extends forward opposite hind pupil edge. Gill rakers 16 + 26, short, simple points, $\frac{1}{5}$ of gill filaments, which are 2 in eye.

Scales 39 + 4 in lateral line; 7 above to dorsal origin, 6 below to ventral origin, 5 below to anal origin, 15 predorsal. Along front of dorsal base 3 scales and along front of anal 2 scales. Caudal base scaly. Axillary ventral scale $2\frac{1}{4}$ in fin. On each side of predorsal and anteriorly some of scales with finely crenulated edges.

D. III, 9, first branched ray $1\frac{1}{6}$ in head; adipose fin $3\frac{7}{8}$; A. III, 7, first branched ray $1\frac{4}{5}$; least depth of caudal peduncle $2\frac{3}{5}$; caudal well forked, upper lobe little longer and $2\frac{7}{8}$ in rest of fish; pectoral $1\frac{4}{7}$ in head, rays I, 13; ventral rays I, 8, fin $1\frac{3}{7}$ in head, when depressed not reaching vent.

Color in alcohol brown, paler below, evidently whitish in life. On back and sides, at junctures of scales, a slightly darker longitudinal streak. Axially and along above lateral line a diffused pale longitudinal band, subdued and not prominent. At middle of side posteriorly and between adipose fin and anal a black band, narrow at first and then equals 2 scales in width at caudal base, posteriorly extending well out on median caudal rays but not to their posterior ends. Along lower subbasal region of lower caudal lobe diffuse dark to blackish area. Fins otherwise than noted all pale brown, front edge of dorsal and upper edge of adipose fin grayish.

A.N.S.P., no. 70,490. Florencia, Colombia. Length 104 mm. Type.

Only the type obtained. Apparently approaches *Curimata gilbert* Quoy and Gaimard,[1] poorly figured with the eye nearly half the length of the snout, the small caudal about as long as the head and the dark spot on the side of the caudal base extended over 5 scales at the end of the lateral line but not on the caudal fin. *Curimata niceforoi* clearly differs in proportions and color pattern. A specimen of *Curimata gilbert* from Uruguay about 105 mm. long agrees largely with Quoy and Gaimard's figure. Comparison with *Curimata niceforoi* shows entirely different body contour, fins, proportions, and the absence of broad adipose eyelids.

(For Brother Nicéforo Maria.)

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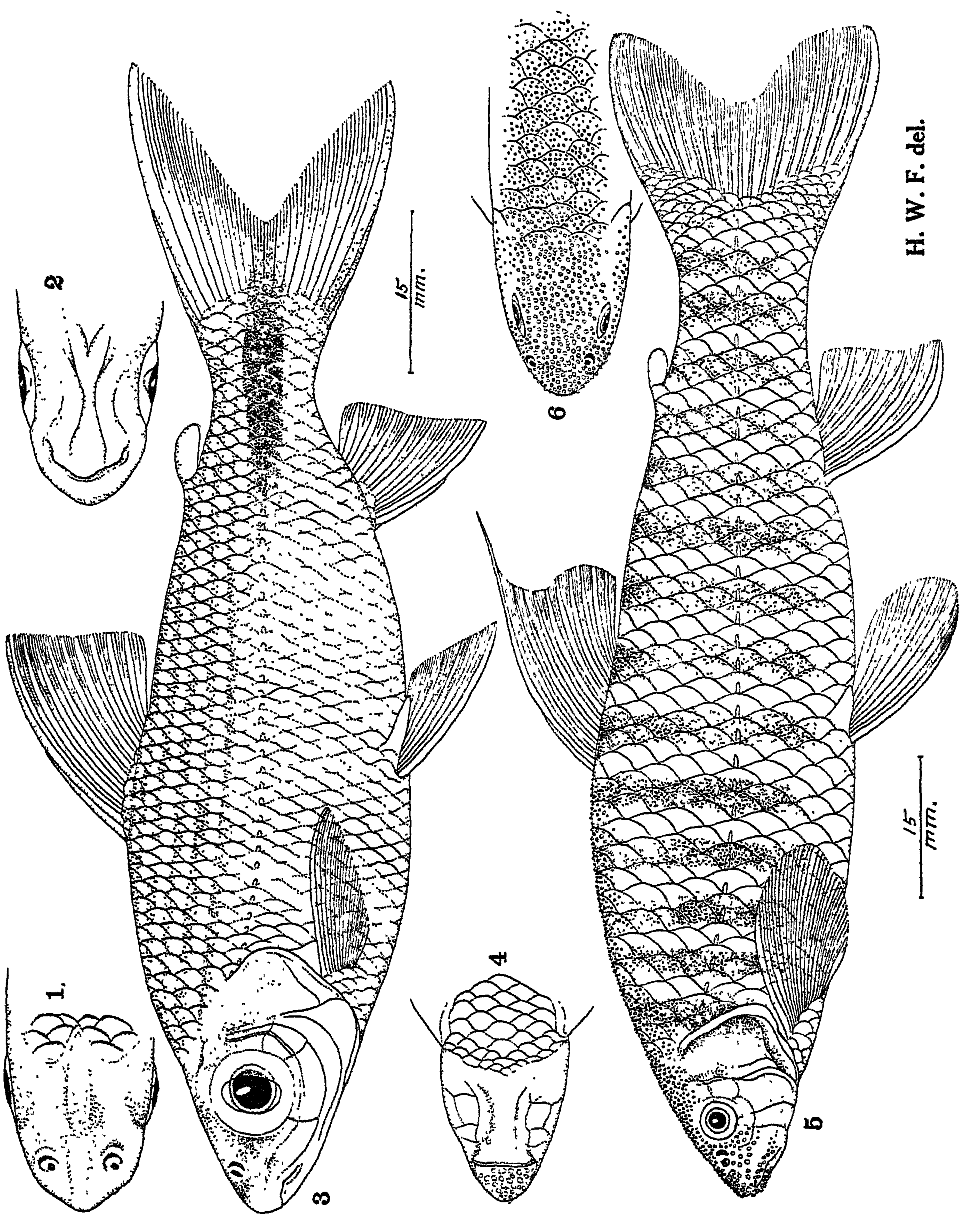
[1] Voy. Uranie, Zool., vol. 2, Poiss., 1828, p. 219, pl. 48, fig. 1 (type locality, Rio Macacu).—Fowler, Proc. Acad. Nat. Sci. Phila., 1905, p. 300 (Rio Grande do Sul; Campos).



FIGS. 1–3.—*Curimata niceforoi* new species.
FIGS. 4–6.—*Parodon apolinari* Myers.

PROCHILODINAE

Prochilodus nigricans Agassiz

Two, 222 to 252 mm., Florencia, 1932. Agree with my east Brazil specimens.[2] Depth 3. Scales 41 + 3 in lateral line. Single series of short, flexible, close-set teeth distinct in both jaws.

PYRRHULINAE

Pyrrhulina lugubris Eigenmann

Two, 48 to 55 mm., Villavicencio, 1931; four, 46 to 61 mm., Rio Ocoá, 1932. In the latter the largest specimen is evidently a male with its fins similar to those shown in Eigenmann's photograph with large ventrals and anal. The black on the dorsal is more extensive, especially contrasted with all the other specimens, where it appears as a simple black blotch anteriorly on the fin.

PARODON Valenciennes

NEMATOPARODON new subgenus

TYPE.—*Parodon apolinari* Myers.

Distinguished from the subgenus *Parodon* Valenciennes by the dorsal extended in a filament, the transverse banded coloration, and the development of minute tubercles or pearl organs on the muzzle, top and sides of the head, and predorsal region.

Apparently one species, described and figured below. Possibly the incompletely described *Parodon gestri* Boulenger may be found to belong to this subgenus, though the type was but 60 mm. long. From the short account no mention is given as to the shape and details of the dorsal fin. The color is said to be olive above and whitish beneath, and with 15 dark vertical rhombs close together across the lateral line.

(*νῆγα* thread + *Parodon;* with reference to the shape of the dorsal.)

Parodon apolinari Myers — Figures 4 (head from below), 5 (lateral view), and 6 (head and predorsal above).

Parodon apolinari Myers, Proc. Biol. Soc. Wash., vol. 43, March 12, 1930, p. 66 (type locality, Guaicaramo, Rio Guavio, Colombia).

Depth $3\frac{3}{5}$ to 4, body edges rounded; head 4 to 5, width $1\frac{1}{2}$ to $1\frac{4}{5}$. Snout (in profile) $2\frac{7}{8}$ to 3 in head, forward tip level with lower edge of pupil in young, well below level of lower eye edge with age; eye 4 to $5\frac{2}{3}$ in head, $1\frac{1}{4}$ to $1\frac{3}{4}$ in snout, $1\frac{3}{4}$ to 2 in interorbital; mouth transversely inferior, width 3 to 4 in head; above 8 broadly compressed transverse incisors, expanded and closely set to form uniform straight cutting-edge; below each side 4 rather slender truncated closely set teeth, ends of each curved outward, symphyseal part of mandible forming broad, straight, transverse, truncated,

[2] Proc. Acad. Nat. Sci. Phila., vol. 93, 1941, p. 168, fig. 81.

coriaceous, trenchant edge; interorbital $2\frac{1}{4}$ to $2\frac{3}{4}$ in head, evenly convex; broad suborbitals cover cheek, extend inferiorly on head. Gill rakers 10 + 15?, very short, lanceolate, slender, feeble, $\frac{1}{4}$ of gill filaments, which are $1\frac{1}{2}$ in the snout.

Scales 31 to 33 + 2 to 4 in lateral line; 5 or 6 above to dorsal origin, 4 below to ventral origin, 5 below to anal origin, 12 predorsal. Ventral with pointed axillary scale $2\frac{4}{5}$ to $3\frac{1}{5}$ in fin. Caudal base scaled for nearly or quite half its length, at least along upper and lower portions. Top and sides of head, including both upper and lower surfaces of snout, and most of entire predorsal region, finely or minutely tuberculate.

D. III, 10, or III, 9, first, or first and second branched rays, extended in filamentous point so its length with age $3\frac{1}{4}$ to 4 in fish without caudal; adipose fin 3 to $3\frac{3}{4}$ in head, larger in young specimens; A. III, 7, first branched ray $1\frac{1}{10}$ to $1\frac{3}{7}$; least depth of caudal peduncle $1\frac{1}{2}$ to $1\frac{3}{4}$; pectoral 1 to $1\frac{1}{10}$, rays I, 16; ventral rays I, 8, fin equals head, depressed, nearly to not quite reaching vent.

Color in alcohol brown, dull, largely uniform and scarcely paler below. On side of body 15 subdued or variably indistinct vertical darker gray transverse bands, equidistant and equal in width to interspaces. In young these often darkest and broadened or more prominent along course of lateral line. Iris dark grayish. Fins uniformly pale or light brown.

Six, 68 to 107 mm., Villavicencio, 1931; two, 118 to 127 mm., Rio Ocoá, 1932.

ANOSTOMATINAE

Anostomus anostomus (Linnaeus)

Salmo anostomus Linnaeus, Syst. Nat., ed. 10, pt. 1, 1758, p. 312 (type locality, "in Indiis" = South America).

Anostomus anostomus Meuschen, Mus. Gronow, 1778, p. 37 (reference).—Eigenmann, Mem. Carnegie Mus., vol. 5, June 1919, p. 294, pl. 40 (colored), pl. 41, fig. 1 (photograph) (British Guiana).—Fowler, Proc. Acad. Nat. Sci. Phila., vol. 66, 1914, p. 236 (Rupununi River, British Guiana).

Eight, 70 to 125 mm., Florencia, 1932.

Leporinus niceforoi new species — Figures 7 (upper and lower dentition), 8 (lateral view of dentition), and 9.

Depth $4\frac{1}{2}$ to $4\frac{2}{3}$; head 4, width 2. Snout $2\frac{2}{3}$ in head, front end level with lower part of eye; eye $3\frac{4}{5}$ to 4, $1\frac{1}{2}$ to $1\frac{2}{3}$ in snout, $1\frac{2}{3}$ in interorbital; maxillary $4\frac{4}{5}$ to 5 in head; lips broad, entire, fleshy; mouth terminal, closed jaws equal; 8 teeth in each jaw, anterior median pair largest and each with broad triturating surface, edges brown; interorbital $2\frac{1}{2}$ to $2\frac{2}{3}$ in head, broadly convex; nostrils lateral on snout, anterior tubular and near first $\frac{2}{3}$ in snout length, posterior with rim little raised and behind anterior at last third in snout; suborbitals narrow, lower half of cheek exposed. Gill opening lateral, reaches opposite hind or vertical edge of preopercle. Gill rakers 8 + 14?, lanceolate, compressed, short, $2\frac{1}{2}$ in gill filaments, which are 2 in the eye.

Scales 33 to 36 + 4 or 5 in lateral line; 5 or 6 above to dorsal origin, 4 below to ventral origin, 4 below to anal origin, 12 predorsal. Short and

broadly triangular extension opposite upper cleft of gill opening. Ventral with pointed axillary scale $2\frac{1}{4}$ in fin. Caudal base well scaled. Row of scales along anal base.

D. II, 10, first branched ray $1\frac{1}{10}$ in head; adipose fin $3\frac{7}{8}$; A. III, 8, first branched ray $1\frac{2}{3}$ to $1\frac{1}{2}$; caudal $1\frac{1}{10}$ to $1\frac{1}{8}$, well forked; pectoral $1\frac{1}{2}$ to $1\frac{3}{4}$, rays I, 17; ventral rays I, 8, fin $1\frac{2}{5}$ to $1\frac{1}{2}$ in head. Vent near last third in space between depressed ventral tips and anal origin.

Color in alcohol brownish, paler on sides and below. Along lateral line 3 black blotches, first largest and below dorsal posteriorly, second largely before anal and third as rounded spot close before caudal base. On back 15 dark transverse bars, mostly broken at level of eye and on preventral lower side of body 4 reflected below lateral line. A similar tinted brownish spot below adipose fin. Iris grayish. Snout and upper surface of head brownish, paler below. Fins all light brownish, unmarked.

A.N.S.P., no. 70491. Florencia, Colombia. 1932. Length 162 mm. Type.

A.N.S.P., no. 70492, same data. Length 154 mm. Paratype.

Suggestive of Roetter's heliotype as published by Borodin as *Leporinus bahiensis* Steindachner[3] in general color pattern, but given with depth $2\frac{3}{4}$ to 3. The 2 black lateral spots shown are also larger, close, and less advanced. If the heliotype is correct it represents very different nostrils, widely separated, the anterior larger and elevated, and the posterior well back before the eye.

(For Brother Nicéforo Maria.)

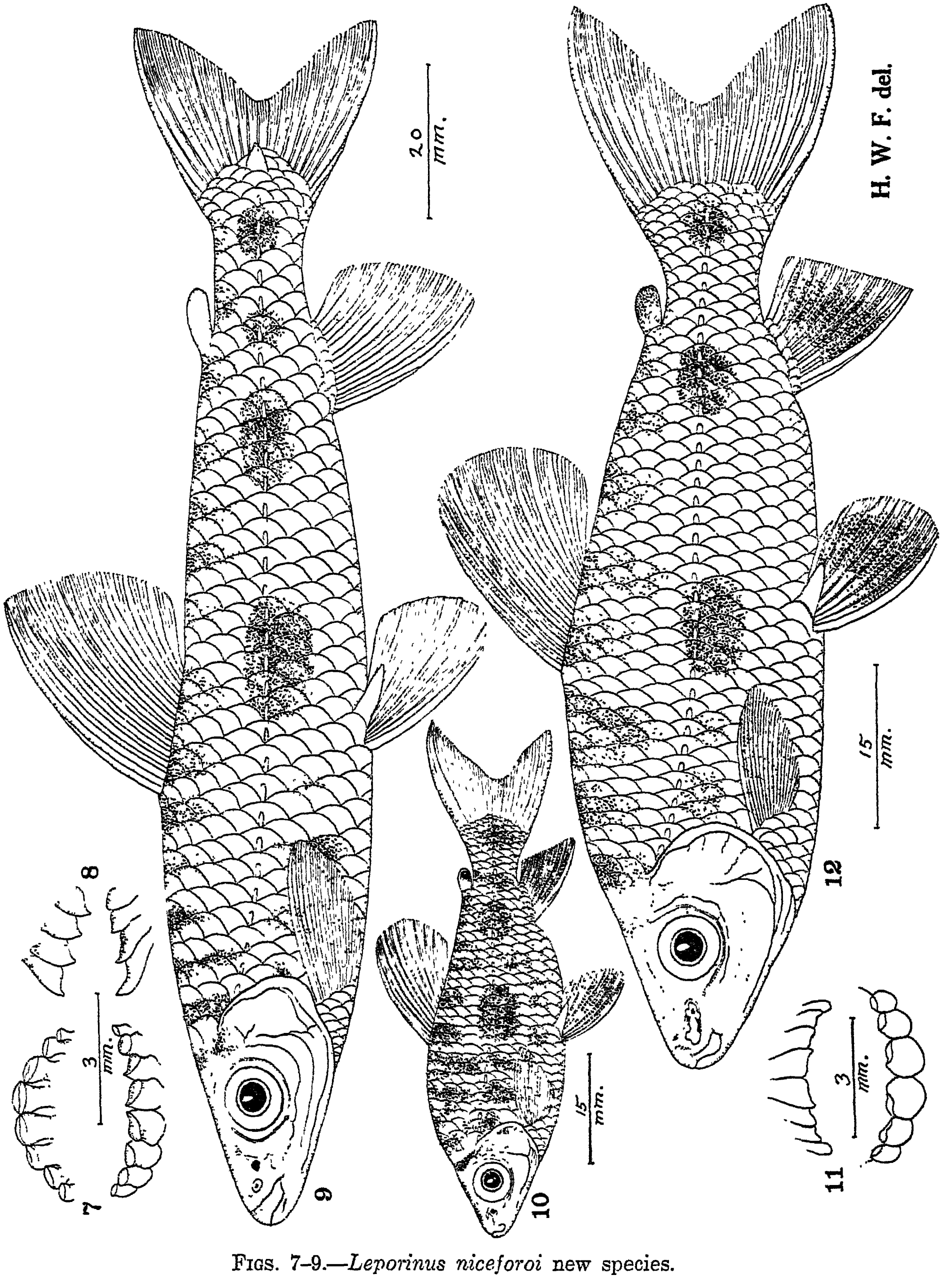
Leporinus subniger new species — Figures 10 (young), 11 (dentition), and 12 (type).

Depth $2\frac{7}{8}$ to $3\frac{1}{8}$; head $3\frac{1}{3}$ to $3\frac{2}{3}$, width 2. Snout (in profile) $2\frac{7}{8}$ to $3\frac{1}{3}$ in head, front end level with middle of eye; eye 3 to $3\frac{2}{3}$ in head, little greater than snout in young to $1\frac{2}{7}$ in snout with age; maxillary short, extends $\frac{1}{7}$ to $\frac{3}{7}$ in snout, length (in profile) $5\frac{1}{4}$ in head; mouth small, terminal, cleft very short, closed jaws even in front; teeth 8 notched incisors above and 6 (damaged) below, median pair largest, each with broad triturating surface; interorbital $2\frac{1}{5}$ in head, broadly convex; nostrils lateral on snout within depression so larger anterior tubular depressible back in groove to posterior, which has moderate cutaneous rim, its position in adult about last third in snout length; suborbitals very narrow, lower $\frac{2}{3}$ or more of cheek exposed. Gill opening lateral, extends forward opposite vertical limb of preopercle. Gill rakers 11 + 15?, lanceolate, compressed, short points about $\frac{1}{3}$ of gill filaments, which are $1\frac{4}{5}$ in eye.

Scales 32 to 34 + 3 or 4 in lateral line; 5 above to dorsal origin, 5 below to ventral origin, 4 below to anal origin, 12 predorsal. Short, broad, triangular occipital extension indistinct, little defined. Ventral with pointed axillary scale $2\frac{1}{5}$ in fin. Caudal base covered with scales little smaller than on body. Row of moderate scales along anal base.

D. II, 10, second branched ray $1\frac{1}{10}$ to $1\frac{1}{5}$ in head; adipose fin length 4 to $4\frac{1}{4}$; A. III, 8, first branched ray $1\frac{1}{3}$ to $1\frac{3}{5}$; least depth of caudal peduncle $2\frac{3}{4}$

[3] Mem. Mus. Comp Zool., vol. 50, no. 3, April 1929, p. 289, pl. 16, figs. 1-5 (Rio Puty, Bahia, Rio Ima).



FIGS. 7–9.—*Leporinus niceforoi* new species.
FIGS. 10–12.—*Leporinus subniger* new species.

to $2\frac{4}{5}$; caudal $2\frac{3}{4}$ to 3 in rest of fish, well forked; pectoral $1\frac{2}{5}$ to $1\frac{2}{3}$, rays I, 15; ventral rays I, 8, fin $1\frac{1}{4}$ to $1\frac{3}{5}$ in head. Vent at last $\frac{1}{4}$ to $\frac{2}{5}$ in space between tips of depressed ventrals and anal origin.

Color in alcohol brown, paler below, evidently whitish in life. On lateral line, though chiefly below, 3 large black blotches; first largest and extends over 5 scales below dorsal largely anteriorly, second before adipose fin, and last on median caudal ray bases less vivid. On back 10 dark brown transverse bands, not reaching down to lateral line, fourth and fifth joined below. In small specimen 14 dark transverse bands on back, with third and fourth, fifth and sixth, and ninth and tenth, joined down above lateral line. In young specimens more dark blotches present below lateral line and adipose fin with blackish posterior blotch. Fins pale brown. Ventrals and anal largely blackish. Iris gray.

A.N.S.P., no. 70493. Florencia, Colombia. 1932. Length 103 mm. Type.

A.N.S.P., no. 70494, same data as type. Length 77 mm. Paratype.

These specimens differ in detail, as shown by the accompanying figures. They are suggestive of Konopicky's lithograph published by Steindachner as *Leporinus bahiensis*.[4] It fails, however, to clearly reveal similar nasal structure, for the posterior nostril appears to be shown as slit-like and rimless, both dorsal and anal comparatively smaller, pectoral reaches ventral and the latter much shorter and more distant from the anal, the black blotches vertically transverse across the lateral line, the ventral darker basally, membranes of anal entirely dark and the hind boundary of the squamous area on base of caudal dark. Steindachner's types were 42 to 89 mm. long.

(*subter* below + *niger* black; with reference to the ventral and anal fins.)

CHEIRODONTINAE

Aphyocharax alburnus (Günther)

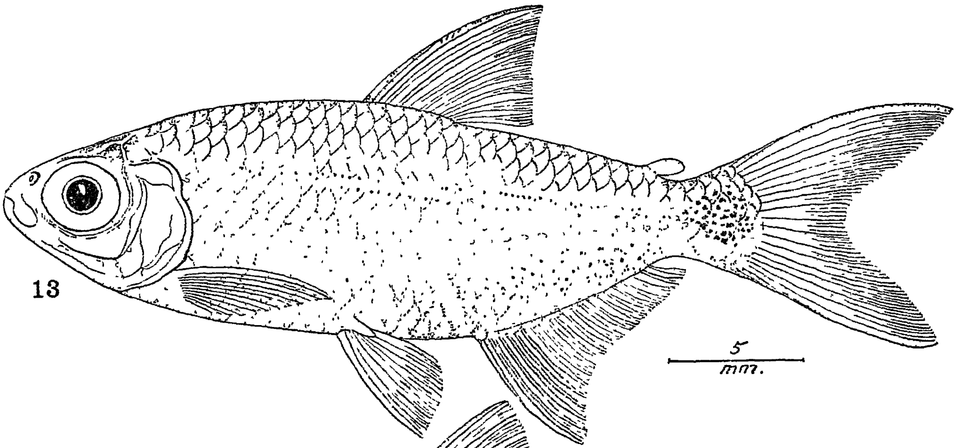
Depth $4\frac{1}{4}$; head $3\frac{4}{5}$. Snout $4\frac{1}{5}$ in head from snout tip; eye 3, greater than snout, subequal with interorbital; maxillary reaches $\frac{1}{4}$ in eye, length $2\frac{7}{8}$ in head from snout tip; interorbital 3; broad suborbitals cover cheek. Tubular scales in lateral line 8, extend opposite ventral; 37 + 4 scales in median axial series; 5 above to dorsal origin, 3 below to ventral origin, 3 below to anal origin, 16 predorsal. D. II, 7; A. III, 14. One of large specimens with a large predorsal and a left abdominal swelling, evidently tumors. Some inconspicuous dark pigment dots at humeral region and medial band along side of tail posteriorly and on caudal peduncle.

Nine, 29 to 60 mm., Florencia, 1932.

Odontostilbe caquetae new species Figure 13.

Depth $3\frac{1}{10}$; head $3\frac{2}{3}$, width 2. Snout (in profile) $5\frac{1}{8}$ in head, front end level with middle of eye; eye $2\frac{1}{3}$, greatly exceeds snout, slightly greater than interorbital; maxillary reaches opposite front of eye, length $4\frac{2}{3}$ in head; mouth with very short cleft, closed jaws equal; teeth uniserial, quindentate,

[4] Sitzs. Akad. Wiss. Wien, vol. 71, pt. 1, 1875, p. 231, pl. 2, fig. 2 (type locality, Bahia).



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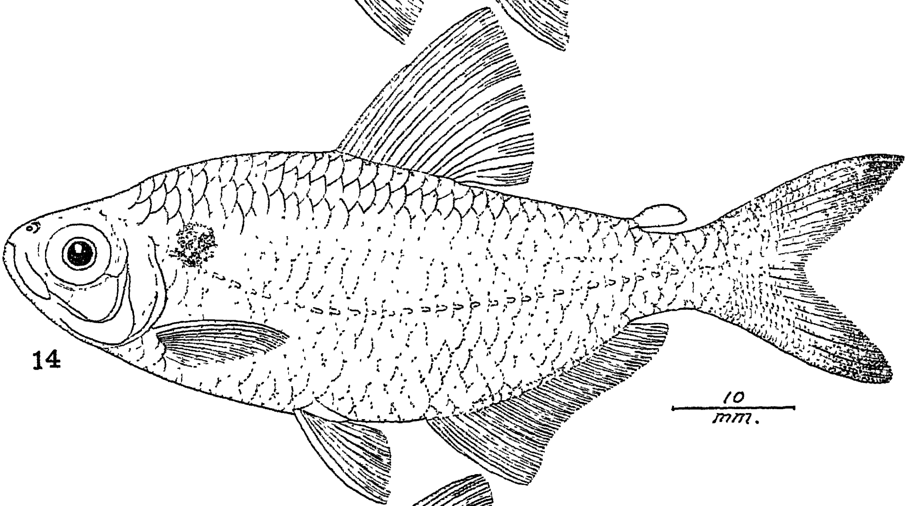

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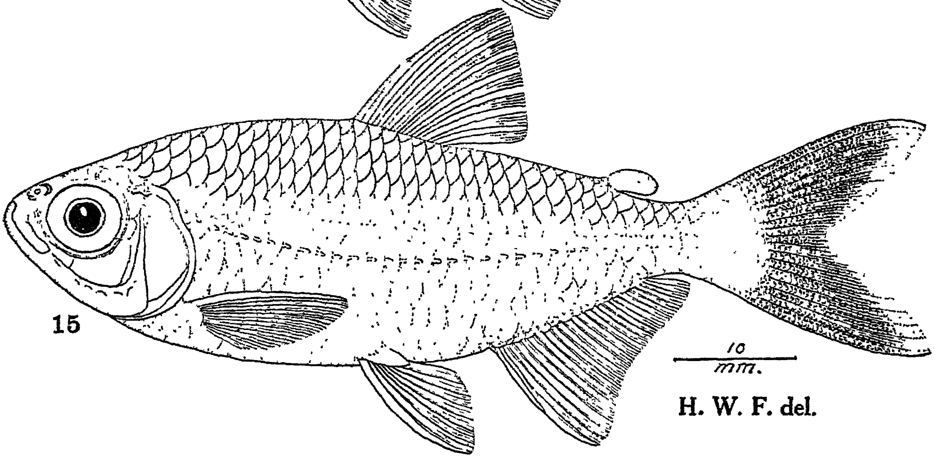

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FIG. 13.—*Odontostilbe caquetae* new species.

FIG. 14.—*Moenkhausia orteguasae* new species.

FIG. 15.—*Moenkhausia lepidura ocoae* new subspecies.

10? apparently on premaxillary and 8 on mandible, and 2 large ones on each maxillary basally; interorbital $2\frac{4}{5}$ in head, broadly convex; suborbital width $\frac{1}{2}$ of eye diameter, covers cheek except narrow naked strip along vertical preopercle ridge. Gill opening extends forward opposite front pupil edge. Gill rakers 7 + 11, lanceolate, slender, pointed, $\frac{2}{3}$ of gill filaments, which are $\frac{2}{3}$ of eye.

Scales 30 + 2 in lateral line; 6 above to dorsal origin, 4 below to ventral origin, 5 below to anal origin, 14 predorsal. Anal with a low band of a few basal scales anteriorly. Humeral extension short. Ventral with pointed axillary scale 4 in fin length. Caudal base scaly. Lateral line complete, decurved, ascends posteriorly to middle of caudal base. Pseudotympanum small, little shorter than eye, very distinct.

D. II, 8, first branched ray equals head; adipose fin $4\frac{1}{5}$; A. III, 20, first branched ray $1\frac{2}{7}$; least depth of caudal peduncle $2\frac{1}{2}$; caudal $2\frac{2}{3}$ in rest of fish, well forked, fulcra moderate; pectoral $1\frac{1}{5}$ in head, not quite reaching ventral, rays I, 10; ventral rays I, 7, fin $1\frac{1}{3}$ in head. Vent little before anal.

Color in alcohol brown, little paler below, evidently whitish in life. Scales on back above with dark brown borders. Top of head with large dark brown blotch, over hind part of eye. Along side of body axial gray streak, with some dark dots. Also some dark dots along lower side of tail and above anal. Caudal base with group of crowded small black spots, area in extent but little less than eye. Iris grayish. Fins pale brownish, front edge of dorsal with dark brown dots.

A.N.S.P., 70495. Florencia, Rio Orteguasa, Colombia. 1932. Length 34 mm. Type.

Only the type known, apparently close to and possibly to be identified with *Odontostilbe fugitiva* Cope,[5] but as shown by that author in a front view of the head the maxillary is longer than the eye. This last is said to equal the interorbital width (according to the figure it would be computed at 3 times the eye) and be $2\frac{1}{2}$ in the head. The pectoral is said barely to reach the ventral. I am unable to ascertain these details as the type is lost. Eigenmann in 1915 identifies 4 specimens, largest 41 mm., from San Antonio da Rio Madeira, with *O. fugitiva*, and in his key to the species gives the mouth as minute and the maxillary half the length of the eye. Here also the " A. 22-34 " appears erroneous for A. 22 to 24. Differences with the present species are the smaller head ($4\frac{1}{2}$), smaller eye ($2\frac{3}{4}$ to 3) and larger snout ($\frac{2}{3}$ of snout). Although Cope mentions a dark spot at the caudal base this notation is so brief and undefined as to be of little value.

Eigenmann also says of *O. drepanon* Fowler that " it is quite possible that it will prove to be synonymous with *O. fugitiva*." Points at variance are head $3\frac{1}{4}$ to $3\frac{2}{3}$ (4 in *O. fugitiva*). The extended dorsal and ventral points in *O. drepanon* could hardly have been unnoticed in Cope's type of *O. fugitiva*, a specimen 50 mm. long.

(Named for the Rio Caquetá.)

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[5] Proc. Amer. Philos. Soc., vol. 11, 1870, p. 566, text fig. (front view of head) (type locality, Pebas, Eastern Ecuador).

TETRAGONOPTERINAE

Tetragonopterus chalceus Agassiz

Tetragonopterus chalceus Agassiz, Select. Gen. Spec. Pisc. Brasil., 1829, p. 70, pl. 33, fig. 1 (type locality, in Brasiliae aequinoctialis fluviis).—Eigenmann, Mem. Mus. Comp. Zool., vol. 43, pt. 1, Aug. 1917, p. 59, pl. 4, fig. 1 (photograph), pl. 98, fig. 4 (radiograph) (Guiana, Brazil).

One, 79 mm., Florencia, 1932. Depth 2. A. III, 22. Eye $1\frac{1}{5}$ in interorbital. Occipital extension with 4 scales on each side. Dark axial lateral band and basal caudal blotch apparently intensified by preservation.

Moenkhausia metae Eigenmann

Moenkhausia metae Eigenmann, Mem. Carnegie Mus., vol. 9, no. 1, Oct. 1922, p. 234, pl. 34, fig. 3 (photograph) (type locality, Barrigon, Rio Meta; Villavicencio).

Three, 55 to 64 mm., Villavicencio, 1931. Axial dark line much narrower than in the following. Twenty, 53 to 78 mm., Rio Ocoá, 1932.

Eigenmann's photographic figure is so obscured and without detail that it is of little use. My specimens are all brown, evidently resulting from preservation, and show the narrow black axial line from the gill opening and not quite reaching the caudal base, but narrowly constricted along the side of the caudal peduncle. An expanded nebulous dark blotch rather close behind the gill opening. Lower edge of anal dark gray. Scales 5 below lateral line to ventral origin.

Moenkhausia oligolepis (Günther)

Two, 41 to 45 mm., Villavicencio, 1931; two, 63 to 84 mm., Florencia, 1932.

Moenkhausia orteguasae new species Figure 14.

Depth $2\frac{3}{5}$, back with keel in posterior half of predorsal; head $4\frac{1}{8}$, width $2\frac{1}{10}$. Snout (in profile) 4 in head measured from snout tip which is level with upper edge of pupil; eye $2\frac{1}{2}$, exceeds snout or interorbital; maxillary long, extends below front edge of eye, length $2\frac{1}{5}$ in head measured from snout tip; mouth cleft very short, closed mandible slightly protruding in front; teeth small, with 6? small inconspicuous ones forming outer row close to larger 10 quindentate ones of inner row; no teeth on maxillary; mandible with 8 large quindentate teeth and several other small ones each side posteriorly; interorbital $2\frac{3}{4}$ in head from snout tip, broadly convex; occipital fontanel distinct, begins opposite middle of internasal and reaches into occipital extension, tip of which is opposite hind edge of gill opening, with 3 scales bordering along each side; suborbitals largely cover cheek, broad suborbital in contact below with horizontal ridge of preopercle. Gill opening reaches opposite front pupil edge. Gill rakers 9 + 13?, lanceolate, slender, lower longer and $\frac{2}{3}$ of gill filaments, which are $\frac{1}{2}$ of eye.

Scales 33 + 2 in lateral line; 6 above to dorsal origin, 4 below to ventral origin, 5 below to anal origin, 14 predorsal. Caudal largely scaled basally. Row of small scales along anal base. Ventral pointed axillary scale $2\frac{1}{3}$ in fin. Lateral line complete, well decurved, reaches middle of caudal base.

D. II, 8, first branched ray $3\frac{1}{2}$ in fish without caudal; adipose fin length $1\frac{1}{4}$ in eye; A. III, 27, first branched ray $1\frac{3}{7}$ in total head length; least depth of caudal peduncle $2\frac{1}{8}$; caudal $3\frac{1}{8}$ in rest of fish, well forked, lobes similar; pectoral $1\frac{1}{6}$ in total head length, rays I, 11; ventral rays I, 7, fin $1\frac{1}{4}$ in total head length.

Color in alcohol brown, but little paler below. An axial gray band, not wider than pupil (doubtless silvery white in life) and reflected over median caudal rays to their posterior ends. A diffuse dark spot above lateral line 2 scales from head, smaller than eye. Iris dark gray (evidently silvery white in life). Fins more or less pale brownish, end of each caudal lobe blackish.

A. N. S. P., no. 70496. Florencia, Rio Orteguasa, Colombia. 1932. Length 73 mm. Type.

Only the type obtained. Related to *Tetragonopterus dichrourus* Kner[6] shown in his lithograph with the body depth $2\frac{1}{2}$, median black caudal bands about half length of either lobe with entire base of fin pale and scaled, the short maxillary (mouth extended) would not reach beyond front eye edge, 4 scales between lateral line and ventral origin. Other points at variance are the dark terminal membranes of the dorsal, the depressed dorsal length computed as $1\frac{3}{5}$ to adipose fin origin ($1\frac{2}{5}$ in *M. orteguasae*), the presence of a longitudinal subbasal dark band on the anal, the greatly smaller eye, and the anal origin indicated well behind the base of the last dorsal ray. Eigenmann has separated *Moenkhausia dichrourus intermedius* of the Amazon chiefly on the maxillary shown more expanded posteriorly and its profile less arched. *M. orteguasae* appears to differ in the maxillary more straightened, also the body deeper and the ends of the caudal lobes entirely blackish.

(Named for the Rio Orteguasa.)

Moenkhausia lepidura ocoae new subspecies Figure 15.

Depth $2\frac{7}{8}$; head $3\frac{3}{5}$, width $2\frac{1}{10}$. Snout (in profile) 5 in head measured from snout tip which is level with upper part of pupil; eye $2\frac{3}{4}$, greater than snout or interorbital; maxillary long, reaches below front eye edge, length $3\frac{1}{10}$ in head from snout tip, uniformly wide with lower edge not very convex; mouth cleft very short, small, closed jaws with mandible protruding in front; teeth above biserial, 8 larger in inner row, none on maxillary, and 8 large ones in mandible; interorbital 3 in head measured from snout tip, broadly convex; broad occipital fontanel begins over front of eye and reaches into occipital extension, which ends opposite middle of opercle and with 3 bordering scales each side; broad suborbitals cover cheek, in contact below with horizontal ridge of preopercle, leaving narrow naked strip in front and another along vertical edge. Gill opening extends forward opposite front pupil edge. Gill rakers 8? + 11, lanceolate, slender, long as gill filaments or $\frac{2}{5}$ of eye.

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[6] Denks. Akad. Wiss. Wien, vol. 17, 1859, p. 177, pl. 9, fig. 21 (type locality, Rio Guapore).

Salmo lambari Natterer, in Kner, op. cit., p. 179 (type locality, Caicara and Rio Paraguay) (no diagnosis).

Scales (mostly fallen) 32? + 3? in lateral line; 6 above to dorsal origin, 3 below to ventral origin, 4 below to anal origin, 15 predorsal. Ventral with pointed axillary scale $2\frac{7}{8}$ in fin. Row of small scales along anal base slightly overlap along fin base. Caudal largely scaly basally, scales smaller on fin rays. Lateral line apparently continuous, decurved, reaching middle of caudal base, with small tubes.

D. II, 8, first branched ray $1\frac{1}{10}$ in total head length; adipose fin $1\frac{1}{4}$ in eye; A. II, 22, first branched ray $1\frac{3}{7}$ in total head length; least depth of caudal peduncle $2\frac{7}{8}$; caudal $2\frac{3}{4}$ in rest of fish, well forked; pectoral not quite reaching ventral, length $1\frac{1}{5}$ in total head length, rays I, 12; ventral rays I, 7, fin $1\frac{1}{3}$ in total head length.

Color in alcohol brown, scarcely paler below. Along middle of side of body brown axial band, with median dark line its entire extent, evidently silvery white in life above lateral line and close behind gill opening dark diffuse blotch smaller than eye. Iris gray. Caudal with basal half cream-white and most of outer half of fin contrasted black, with ends and most of hind edge of lobe white. Otherwise fins all pale and largely uniform brownish.

A. N. S. P., no. 70497. Rio Ocoá, Rio Meta basin, Colombia. 1932. Length 40 mm. Type.

Only the type obtained. It differs from the other subspecies arranged under *Moenkhausia lepidura* by Eigenmann in having the entire base of the caudal fin white and most of the outer half of each caudal lobe black, the tips pale. I am unable to find *M. lepidura* reported from the Orinoco basin.

Comparison with the types of *Moenkhausia lepidura madeirae* Fowler [7] shows that form quite differently marked, besides having a much more slender body. That form was synonymized by Eigenmann with his *M. dichrourus intermedius* of 1908 from Tabatinga, in which the body depth was subsequently given as 3 ($3\frac{3}{4}$ to 4 in *M. lepidura madeirae*). Compared with my drawing of the type it and all the paratypes show the tips and upper and lower borders of the black caudal areas pale.

(Named for the Rio Ocoá.)

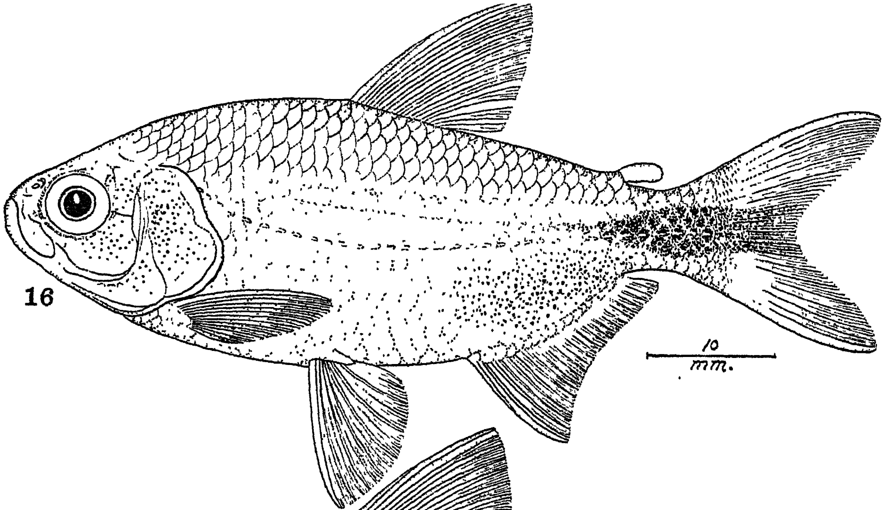
Hemigrammus barrigonae Eigenmann and Henn

Hemigrammus barrigonae Eigenmann and Henn, Indiana Univ. Stud., no. 24, 1914, p. 232 (type locality, Barrigona, Rio Meta, Colombia).—Eigenmann, Mem. Mus. Comp. Zool., vol. 43, pt. 2, Jan. 1918, p. 161, pl. 9, fig. 2 (photograph) (types).

Ten, 43 to 54 mm., Rio Ocoá, 1932. Narrow black axial lateral band from gill opening to caudal base and reflected out on median caudal rays. Behind gill opening nebulous dark blotch in dark lateral band, also expanded into black blotch at caudal base. Anal with conspicuous black basal band its entire extent and narrowed posteriorly. Outer margin of anal blackish.

[7] Proc. Acad. Nat. Sci. Phila., vol. 65, 1913, p. 540, fig. 11 (type locality, tributary of Rio Madeira near Porto Velho, Brazil).

16



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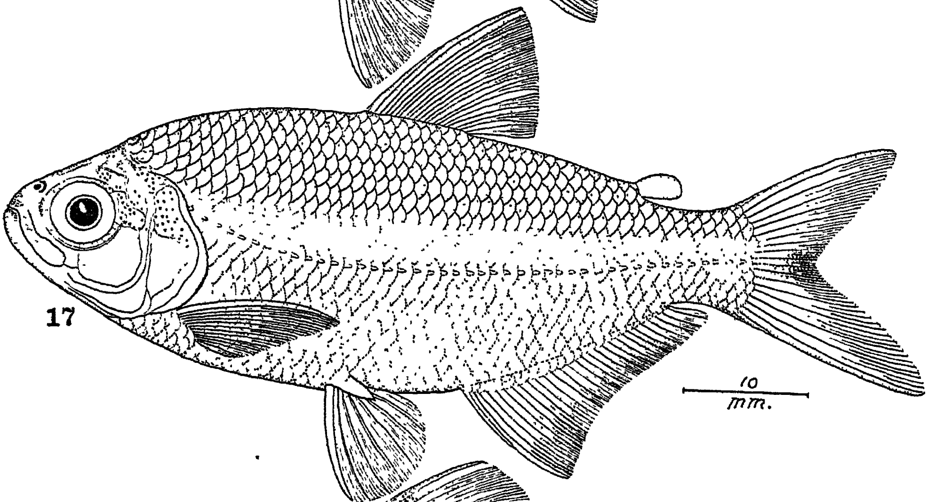

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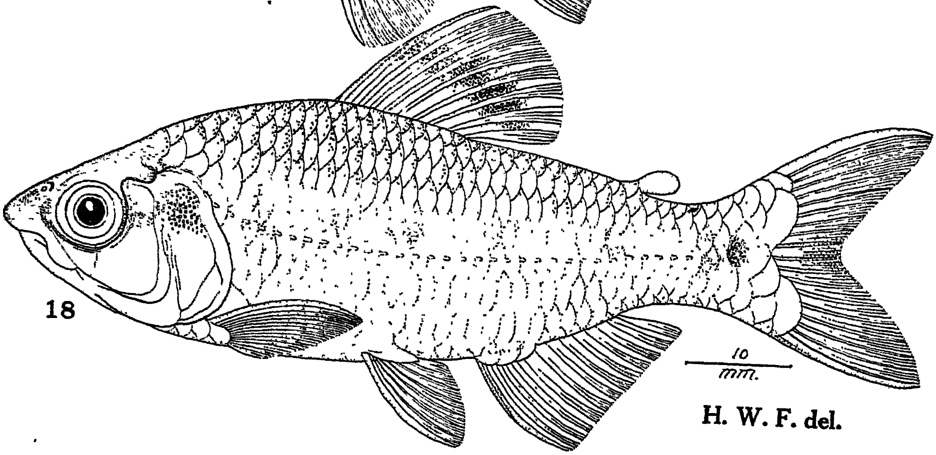

H. W. F. del.

FIG. 16.—*Astyanax fasciatus orteguasae* new subspecies.

FIG. 17.—*Astyanax integer* Myers.

FIG. 18.—*Creagrutus amoenus* new species.

Astyanax bimaculatus (Linnaeus)

Nine, 58 to 84 mm., Rio Ocoá; five, 73 to 118 mm., Florencia; all in 1932. One, 80 mm., from an acequia, Aracataca, Magdalena Department, obtained by Messrs. J. A. G. Rehn and Morgan Hebard, August 13, 1920.

Astyanax fasciatus fasciatus (Cuvier)

Four, 54 to 60 mm., San Gil, August 1931; five, 63 to 82 mm., Sonsón, 1931; two, 70 to 117 mm., Villavicencio, 1931; two, 99 to 119 mm., Sasaima, 85 kilometers northwest of Bogotá, 1932; one, 138 mm., Villavicencio, 1932.

Astyanax fasciatus orteguasae new subspecies Figure 16.

Depth $2\frac{3}{5}$; head 3, width $2\frac{1}{8}$. Snout (in profile) 6 in head measured from snout tip, which is level with middle of eye; eye $3\frac{1}{4}$, greatly exceeds snout, equals interorbital; maxillary long, extends below and little beyond front edge of eye, length 3 in head; mouth cleft short, closed jaws with mandible protruded in front; teeth 8 in outer upper series well covered by lips, also 8 broader ones in second row; maxillary with single small basal tooth; 8 large teeth in front of mandible, followed by 3 or 4 small ones each side; interorbital 3 in head measured from snout tip, broadly convex; occipital fontanel begins in mid-interorbital space and reaches into supra-occipital extension, which ends opposite middle of opercle and furnished with 3 scales on each side; suborbitals broad, largely cover cheek, with narrow naked strip below all along horizontal ridge of preopercle, in contact behind with vertical ridge of preopercle. Gill opening extends forward opposite hind edge of maxillary. Gill rakers 11 + 15, lanceolate, slender, equal gill filaments or $\frac{1}{2}$ of eye.

Scales 33? + 3? (damaged) in lateral line; 8 above to dorsal origin, 7 below to ventral origin, 7 below to anal origin, 15 predorsal. Ventral with pointed axillary scale $3\frac{2}{5}$ in fin. Band of scales along anal base, diminishing posteriorly. Caudal base scaly. Lateral line complete, little decurved, rises posteriorly to middle of caudal base, tubes simple.

D. II, 9, first branched ray $1\frac{1}{8}$ in total head length; adipose fin subequal with eye; A. III, 25, first branched ray $1\frac{7}{8}$ in total head length; caudal 1, well forked; least depth of caudal peduncle $2\frac{3}{4}$; pectoral $1\frac{2}{3}$, rays I, 12; ventral rays, I, 7, fin $1\frac{1}{2}$ in total head length. Vent little nearer anal origin than ventral base.

Color in alcohol brown, above and on side with scattered inconspicuous dark dots, also larger ones on sides of head and above anal on lower side of tail. Under surfaces paler, evidently whitish in life. Along side an axial silvery band, less than eye in width, from upper hind edge of gill opening and with median longitudinal dark line. No dark post-scapular blotch. Caudal peduncle with very conspicuous and contrasted large black blotch over twice eye in length and reflected out over 4 median rays of caudal to their hind ends. Caudal otherwise whitish. Fins light or pale brownish.

A.N.S.P., no. 70498. Florencia, Rio Orteguasa, Colombia. 1932. Length 72 mm. Type.

Apparently distinctive in the large contrasted black blotch on the caudal peduncle and caudal base at least equal to 2 eye diameters and also reflected out over the median caudal rays. No dark scapular blotch.

(Named for the Rio Orteguasa.)

Astyanax integer Myers Figure 17.

Astyanax integer Myers, Proc. Biol. Soc. Wash., vol. 43, March 12, 1930, p. 67 (type locality, Guaicaramo, Rio Guavio in the Rio Meta basin, Colombia).

Depth $2\frac{3}{5}$ to $2\frac{2}{3}$; head $3\frac{2}{5}$ to $3\frac{1}{2}$, width $2\frac{1}{5}$ to $2\frac{1}{4}$. Snout (in profile) 4 to $5\frac{1}{5}$ in head from snout tip, which is level with middle of eye; eye 3 to $3\frac{1}{5}$, greater than snout, subequal with interorbital; maxillary reaches below front eye edge or slightly beyond, length $2\frac{1}{3}$ to $2\frac{1}{2}$ in head from snout tip; mouth cleft very short, closed jaws equal or lower only slightly protruding in front; upper teeth 10 in outer row, 8 in inner row; maxillary with small basal tooth; mandible with 5 large teeth in front of jaws, followed each side by 3 small inconspicuous ones; interorbital $2\frac{7}{8}$ to 3 in head measured from snout tip, broadly convex; occipital fontanel begins over front part of eye and reaches back into supra-occipital extension, last bordered each side by 4 scales and extends upward until opposite middle of opercle; suborbitals cover cheek, leaving only narrow strip of skin all along ridge of preopercle, nowhere in contâct. Gill opening extends forward opposite front eye edge. Gill rakers 9 + 17?, slender, lanceolate, subequal with gill filaments or $2\frac{1}{5}$ in eye.

Scales 40 or 41 + 3 in lateral line; 10 above to dorsal origin, 7 below to ventral origin, 7 to 9 below to anal origin, 14 to 18 predorsal. Ventral with pointed axillary scale $2\frac{1}{3}$ to $2\frac{7}{8}$ in fin. Anal with row of basal scales narrowing posteriorly. Caudal scaly basally. Lateral line complete, little decurved, ascending caudal base medially, and small tubes simple.

D. I, 9, first branched ray $1\frac{1}{8}$ in total head length; adipose fin $1\frac{1}{8}$ to $1\frac{1}{3}$ in eye; A. III, 27, first branched ray $1\frac{1}{2}$ to $1\frac{2}{3}$ in total head length; least depth of caudal peduncle $2\frac{1}{4}$ to $2\frac{2}{3}$; caudal $3\frac{1}{8}$ to $3\frac{1}{6}$ in rest of fish, forked; pectoral $1\frac{1}{5}$ to $1\frac{1}{4}$, rays I, 12, reaches ventral; ventral I, 7, fin $1\frac{2}{5}$ to $1\frac{2}{3}$ in total head length.

Color in alcohol brown, little paler below. Back above more or less shaded with dull olive-gray. Along side of body broad light axial band, expanded little at caudal base and becoming rather dark gray on hind ends of median caudal rays. Anal, slightly deeper brownish. Humeral diffusion less than eye. Fins and iris pale brownish.

Two, 80 and 88 mm., Villavicencio, 1931.

Creagrutus beni Eigenmann

Creagrutus beni Eigenmann, Ann. Carnegie Mus., vol. 8, no. 1, Dec. 1911, p. 172 (type locality, Villa Bella on Rio Beni, Bolivia); Mem. Mus. Comp. Zool., vol. 43, pt. 2, Jan. 1918, pl. 13, figs. 4-5 (upper teeth), 7 (lateral view); vol. 43, pt. 4, May 1927, p. 421, pl. 58, fig. 3 (photograph).—Fowler, Proc. Acad. Nat. Sci. Phila., vol. 83, 1931, p. 408 (Yarapa River, Venezuela); vol. 92, 1940, p. 100 (reference).

Three, 64 to 73 mm., Villavicencio, 1931; ten, 77 to 90 mm., Rio Ocoá, 1932. All show a rather broad naked strip of skin along the vertical ridge of the preopercle separating the hind edge of the suborbital and along the horizontal edge below nowhere is the lower edge of the suborbital in contact.

In one specimen 2 large scales intervene between the lateral line and the ventral fin while on the other side are 4 scales (3 the usual number on both sides). The black basal caudal spot more or less reflected back on the median caudal rays, a condition not shown in any of the figures. All my specimens with the edges of the scales on the back broadly darkened.

Creagrutus amoenus new species Figure 18.

Depth $2\frac{3}{4}$ to 3; head $3\frac{1}{8}$ to $3\frac{1}{5}$, width 2 to $2\frac{1}{4}$. Snout (in profile) 4 to $4\frac{1}{3}$ in head, tip falls but slightly below level of center of eye; eye $3\frac{1}{10}$ to $3\frac{2}{5}$ in head, greater than snout, little greater than interorbital in young to subequal with age, also with marginal membrane moderately developed with age; maxillary long, reaches $\frac{2}{5}$ to $\frac{3}{7}$ in eye, falls well down below lower eye edge for space equal to $\frac{3}{5}$ of vertical eye-diameter, length $2\frac{1}{3}$ to $2\frac{1}{2}$ in head; lips fleshy, thick, cover outer teeth above and 9 or 10 in the inner row but more segregated, 1 or 2 small basal teeth on each maxillary and row of 6 lower large teeth anteriorly followed by 1 or 2 small ones each side; interorbital $3\frac{1}{4}$ to $3\frac{1}{2}$ in head, broadly convex; occipital fontanel begins over front of eye and reaches into short occipital extension which is bordered on each side by 2 scales and its hind tip opposite vertical edge of preopercle; suborbitals broad, second nearly or quite in contact with horizontal ridge of preopercle, and posteriorly all suborbitals leave naked strip of skin before vertical ridge of preopercle. Gill opening extends forward opposite front edge of pupil. Gill rakers 9 + 11, lanceolate, slender, $1\frac{1}{5}$ in gill filaments, which are 2 in eye.

Scales 32 or 33 + 2 in lateral line; 5 or 6 above to dorsal origin, 3 below to ventral origin, 3 or 4 below to anal origin, 10 or 11 predorsal. Scales on sides of body all rather deeply imbricated. Pointed axillary ventral scale $2\frac{1}{5}$ to $2\frac{1}{3}$ in fin. On front of anal base 3 or 4 low scales forming short sheath. Caudal base broadly scaly and usually several of posterior ones enlarged. Lateral line complete, slightly decurved and reaches middle of caudal base, tubes small and simple.

D. III, 8, first branched ray $1\frac{1}{4}$ to $1\frac{2}{5}$ in head; adipose fin $1\frac{1}{6}$ in eye; A. III, 12 or III, 11, first branched ray $1\frac{3}{4}$ to $1\frac{9}{10}$ in head; least depth of caudal peduncle $2\frac{1}{5}$ to $2\frac{1}{3}$; caudal slightly less to subequal with head, forked; pectoral $1\frac{2}{5}$ to $1\frac{4}{7}$ in head, rays I, 13; ventral rays I, 7, fin $1\frac{2}{3}$ to $1\frac{7}{8}$ in head.

Color in alcohol brown, paler below, evidently whitish in life. Along middle of side of body gray axial band, less than eye in width, evidently bright silvery white in life. It is also reflected as dark bar on post-ocular region and side of snout. On body in course of lateral band 6 more or less clearly defined dark blotches. Iris gray. Edges of most of scales on back bordered with darker. Median caudal rays all more or less dark grayish. Mandible pale, like under surface of head. Dorsal and caudal brownish and former with median dark gray to blackish longitudinal band on fin membranes. Lower fins pale.

A.N.S.P., no. 70499. Florencia, Rio Orteguasa, Colombia. Length 88 mm. 1932. Type.

A.N.S.P., nos. 70500 to 70503, some data as type. Length 62 to 87 mm. Paratypes.

Differs from the known species of *Creagrutus* in having the dorsal marked with a dark gray black medial band with age. The dark blotches along the lateral band are distinctive, at least in preserved specimens. Other characters are the more protruding snout and the more or less enlarged basal caudal scales.

In many ways it seems to approach *Creagrutus atrisignum* Myers,[8] though as its caudal squamation is not given identification is uncertain. The description differs in giving the depth $3\frac{1}{2}$, eye 3 in head, pectoral not reaching ventrals by 2 scales, anal origin slightly anterior to vertical of tips of appressed last dorsal ray, and dorsal deeply flushed black but pale basally.

(*amoenus* attractive.)

Bryconamericus caucanus Eigenmann

Bryconamericus caucanus Eigenmann, Indiana Univ. Studies, no. 18, 1913, p. 17 (type locality, Piedra Moler; Paila; Cali; Cartago; Boquia); Mem. Mus. Comp. Zool., vol. 43, pt. 4, May 1927, p. 387, pl. 39, fig. 1 (photograph), pl. 75, figs. 2, 9, 11 (dentition) (Colombia, Peru).

Four, 54 to 78 mm., Medellín, 1932.

Bryconamericus alpha Eigenmann

Bryconamericus alpha Eigenmann, Indiana Univ. Studies, no. 19, 1914, p. 7 (type locality, Villavicencio, Oriente, Colombia); Mem. Carnegie Mus., vol. 9, no. 1, Oct. 1922, p. 236 (Barrigon; Quebrada Cramalote).

Twenty-nine, 48 to 77 mm., Rio Ocoá, 1932. All with broad dark lateral band nearly to quite black, evidently intensified by formalin.

Bryconamericus beta Eigenmann

Bryconamericus beta Eigenmann, Indiana Univ. Studies, no. 19, 1914, p. 7 (type locality, Villavicencio, Colombia); Mem. Mus. Comp. Zool., vol. 43, pt. 4, May 1927, p. 389, pl. 91, fig. 2 (photograph) (types; Venezuela).

Two, 69 to 93 mm., Villavicencio, 1931. Five scales between lateral line and ventral origin. Eigenmann describes the dark lateral band as extending to the ends of the middle caudal rays, though his figure shows it only about $\frac{3}{5}$ their basal length. In my specimens it reaches the tips of the median caudal rays and the anal margin also is much darker than the rest of the fin.

Bryconamericus orteguasae new species Figure 19.

Depth 3; head $3\frac{3}{4}$, width $1\frac{7}{8}$. Snout (in profile) $4\frac{1}{4}$ in head from snout tip, which is level with center of eye; eye 3, greater than snout, $1\frac{1}{10}$ in interorbital; maxillary reaches $\frac{1}{4}$ in eye and to below eye space equal to $\frac{1}{3}$ vertical eye diameter, length $2\frac{3}{5}$ in head measured from snout tip; mouth cleft very short, closed jaws with mandible only slightly protruded in front; upper teeth 8 in outer row, 8 in inner row, 2 small teeth at base of each

[8] Bull. Mus. Comp. Zool., vol. 68, no. 3, July 1927, p. 116 (type locality, Upper Rio Maranhao, upper Tocantins, Goyaz, Brazil; Corrego do Monjolo).

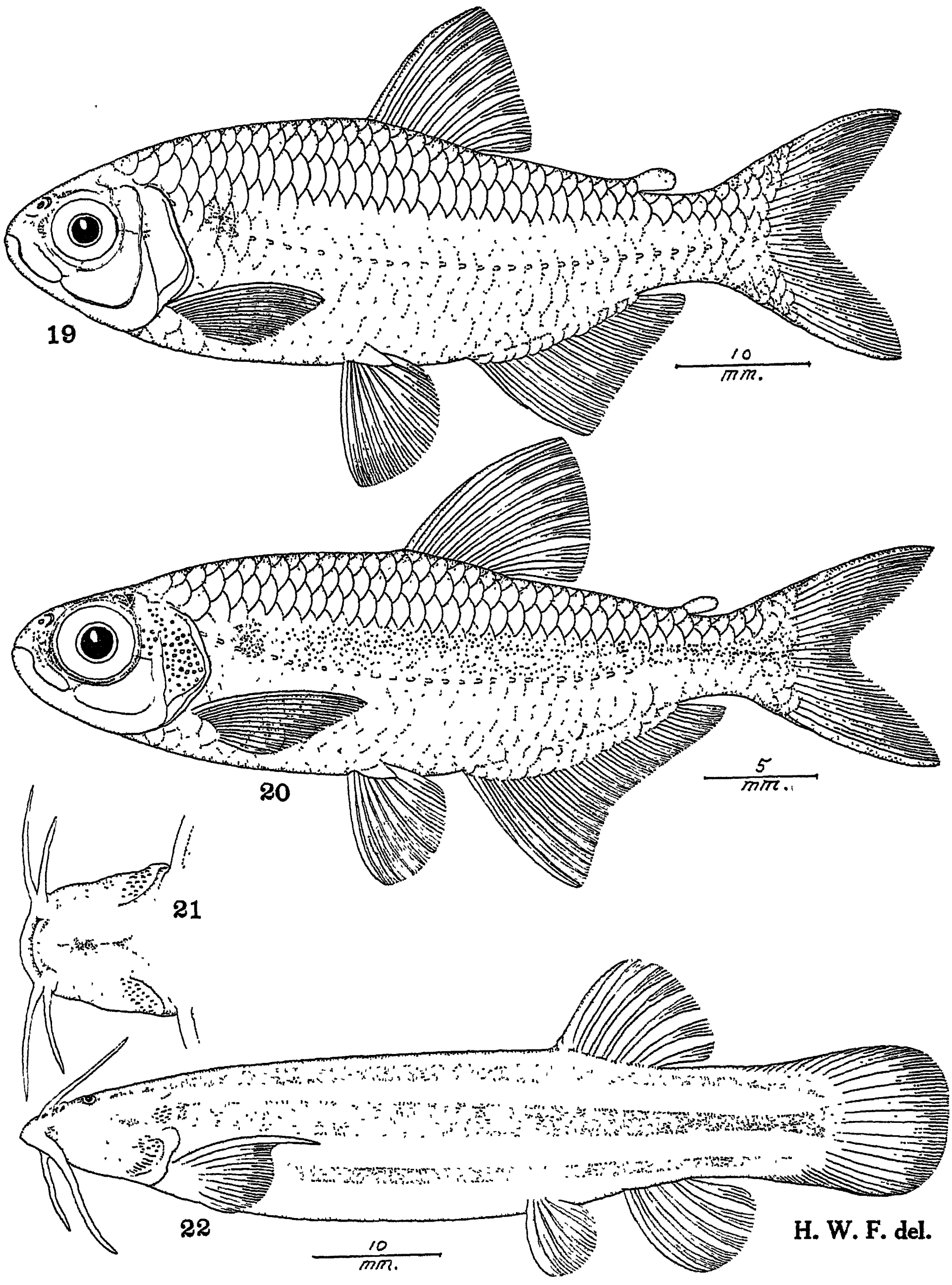

FIG. 19.—*Bryconamericus orteguasae* new species.

FIG. 20.—*Bryconamericus hypopterus* new species.

FIGS. 21–22.—*Pygidium striatum* Meek and Hildebrand.

maxillary, and 8 large anterior lower ones, followed on each side by 1 or 2 very small ones; interorbital $2\frac{7}{8}$ in head from snout tip, low, broadly convex; occipital fontanel begins in middle of interorbital and reaches supra-occipital extension, which is short and broad, bordered each side by 2 scales and terminates opposite lower hind edge of preopercle; second broad suborbital covers cheek and in contact all around with preopercle ridge. Gill opening extends forward opposite front edge of eye. Gill rakers 8 + 10, lanceolate, $1\frac{1}{2}$ in gill filaments, which are $\frac{1}{2}$ of eye.

Scales 33 + 3 in lateral line; 5 above to dorsal origin, 3 below to ventral origin, 4 below to anal origin, 13 predorsal. Anal with basal band of moderate sized scales. Caudal with broad band of scales basally. Ventral with axillary scale $2\frac{1}{4}$ in fin. Lateral line complete, slightly decurved, becoming median at caudal base and small tubes short.

D. II, 8, first branched ray $1\frac{1}{6}$ in total head length; adipose fin $1\frac{1}{4}$ in eye; A. III, 16, first branched ray $1\frac{2}{5}$ in total head length; least depth of caudal peduncle $2\frac{1}{10}$; caudal $3\frac{1}{4}$ in rest of fish, forked; pectoral $1\frac{1}{6}$ in total head length, rays I, 13; ventral rays I, 7, fin $1\frac{1}{2}$ in total head length, reaches little beyond vent.

Color in alcohol brown, paler below. Along middle of side axial gray band, likely bright silvery white in life, and not ending in a distinct or defined caudal spot. Above lateral line 2 scales behind head brownish suffusion forms slight humeral blotch. Iris gray. Dorsal and caudal brownish, other fins paler and uniform.

A.N.S.P., no. 70504. Florencia, Rio Orteguasa, Colombia. 1932. Length 73 mm. Type.

Resembles *Bryconamericus ternetzi* Myers [9] in the small anal (18), depth, head, scales (36) and coloration generally. It differs, however, in the presence of only 2 maxillary teeth, smaller eye ($2\frac{2}{5}$ in *B. ternetzi*), closed jaws even in front, dorsal origin nearly an eye diameter nearer snout tip than caudal base. Moreover, first scale at base of occipital extension is greatly larger than second, which meets its fellow behind tip of the extension. Scaly basal sheath occupies whole base of anal fin.

(Named for the Rio Orteguasa.)

Bryconamericus hypopterus new species Figure 20.

Depth $3\frac{1}{3}$; head $3\frac{3}{4}$, width 2. Snout (in profile) $4\frac{1}{3}$ in head from snout tip, front end level with lower part of pupil; eye $2\frac{2}{3}$, greatly exceeds snout, little greater than interorbital; maxillary reaches $\frac{1}{4}$ in eye and but little below level of its lower edge, length $2\frac{3}{4}$ in head from snout tip; mouth cleft very short and with closed lower jaw but very slightly protruded in front; upper teeth with 2 rows of 8 in each, 2 small close-set teeth at inner base of maxillary and 8 large anterior teeth in mandible followed by 1 or 2 small ones each side; interorbital $2\frac{4}{5}$ in head from snout tip; occipital fontanel broad, begins in middle of interorbital space and reaches short supra-occipital extension which is bordered each side with a single scale and extends opposite vertical ridge of preopercle; broad second suborbital in contact

[9] Ann. Mag. Nat. Hist. London, ser. 10, vol. 2, 1928, p. 89 (type locality Camanaos Rapids, Upper Rio Negro, Brazil).

below with horizontal ridge of preopercle, leaving narrow strip of skin behind and before vertical preopercle ridge. Gill opening extends forward nearly opposite front eye edge. Gill rakers 8 + 10?, slender, lanceolate, $\frac{1}{2}$ of gill filaments which are $\frac{1}{2}$ of eye.

Scales 32 + 2 in lateral line; 6 above to dorsal origin, 3 below to ventral origin, 4 below to anal origin, 14 predorsal. Caudal base well scaled. Band of moderate scales along anal base. Ventral with pointed axillary scale $2\frac{3}{4}$ in fin. Lateral line complete, slightly decurved and reaches caudal base medially, small tubes simple.

D. II, 8, first branched ray $1\frac{1}{10}$ in total head length; adipose fin $1\frac{4}{5}$ in eye; A. III, 21, first branched ray $1\frac{1}{5}$ in total head length; least depth of caudal peduncle $2\frac{1}{2}$; caudal $3\frac{1}{2}$ in rest of fish, well forked; pectoral $1\frac{1}{10}$ in total head length, rays I, 12; ventral rays I, 7, fin $1\frac{3}{5}$ in total head length.

Color in alcohol brown, little paler below, now nearly uniform. Brownish humeral spot, little contrasted, mostly above lateral line and at its third scale. A broad silvery axial band, narrower on caudal peduncle, now with dark pigment dots showing through, though likely little evident in life. Iris gray. Dark pigment dots on postocular region and opercle. Fins pale brownish.

A.N.S.P., no. 70505. Florencia, Rio Orteguasa, Colombia. 1932. Length 44 mm. Type.

Only the type obtained. Approaches *Bryconamericus pachacuti* Eigenmann[10] in its body depth, fin ray counts and general color. Eigenmann's drawing reveals quite different general appearance, with an elevated dark lateral band, smaller eye, lower mouth, more advanced dorsal with its origin nearer snout tip than the caudal base, lower caudal peduncle, short anterior basal band of anal scales, lower suborbitals completely covering cheek, 4 scales between lateral line and ventral base, 2 scales below lateral line and last anal ray base, and the reduced anterior predorsal scales. If these details are correctly shown they certainly represent a greatly different species.

(ὑπό below + πτερόν fin; with reference to the advanced anal fin.)

Gephyrocharax melanocheir Eigenmann

Two, 28 to 36 mm., from an acequia Aracataca, Magdalena Department, Aug. 1920. Messrs. Rehn and Hebard.

Salminus hilarii Valenciennes

Salminus hilarii Valenciennes, in Cuvier and Valenciennes, Hist. Nat. Poiss., vol. 22, 1849, p. (49) 64 (type locality, Amazon River; Rio San Francisco).—Eigenmann, Ann. Carnegie Mus., vol. 10, nos. 1-2, 1916, p. 92 (Brazilian localities).

One, 310 mm., Florencia, 1932.

Depth $4\frac{1}{3}$; head $3\frac{1}{4}$, width $2\frac{1}{2}$. Snout $4\frac{1}{10}$ in head; eye 6, $1\frac{2}{3}$ in snout, $1\frac{2}{3}$ in interorbital; maxillary reaches well beyond eye, length 2 in head; interorbital $3\frac{1}{2}$. Scales 66 + 7 in lateral line; 12 above to dorsal origin, 5 below to ventral, 7 below to anal origin, 33 predorsal. D. III, 9; A. III, 21.

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[10] Mem. Mus. Comp. Zool., vol. 43, pt. 4, May 1927, p. 376, pl. 99, fig. 3 (type locality, Santa Anna, Rio Bamba, Peru; Rio Canberciata).

Pectoral $1\frac{3}{5}$ in head; ventral $2\frac{1}{3}$. Brown, paler below. Each scale with dark spot at base, appearing to form longitudinal narrow dark bands in middle of each scale row. Black band on median caudal rays and little expanded as black blotch at base of caudal fin. Iris gray. Fins brownish.

ERYTHRININAE

Hoplias malabaricus (Bloch)

One, 204 mm., Villavicencio, 1931; eight, 85 to 140 mm., Rio Ocoá, 1932; one, 63 mm., Florencia, 1932.

PIMELODIDAE

Rhamdia sebae (Valenciennes)

Three, 123 to 133 mm., Villavicencio, 1931; sixteen, 111 to 185 mm., Rio Ocoá, 1932. Depth $4\frac{1}{5}$ to $5\frac{2}{3}$. Maxillary barbel reaches $\frac{1}{5}$ to $\frac{2}{3}$ in adipose fin. A. III, 7 or III, 8. Back brown, blotched or mottled with darker to blackish. Dorsal largely blackish brown, with broad cream-white subbasal band. Small diffuse black humeral spot.

Pimelodella metae Eigenmann

Pimelodella metae Eigenmann, Mem. Carnegie Mus., vol. 7, no. 4, April 1917, p. 244, pl. 31, fig. 1, pl. 35, figs. 21-22 (pectoral spines) (type locality, Quebrada Cramalote, Villavicencio; Rio Negro; Barrigona).

Five, 115 to 120 mm., Villavicencio, 1931.

Pimelodus maculatus Lacépède

Two, 210 to 238 mm., Florencia, 1932. Barbels reach back nearly to hind ends of median caudal rays. On body 3 longitudinal rows of dark brown to blackish spots above lateral line and 2 rows below. Head with rather small semi-vermiculate dark spots above and on sides.

The markings on these specimens are quite different from the colored figures published by Valenciennes as *Pimelodus maculatus* in 1847 and *Pimelodus arekaima* by Schomburgk in 1841.

PYGIDIIDAE

Pygidium metae Eigenmann

Pygidium metae Eigenmann, Proc. Amer. Philos. Soc., vol. 56, Jan. 1918, p. 694 (type locality, Barrigona, Colombia); Mem. Carnegie Mus., vol. 7, no. 1, Dec. 1915, p. 312, pl. 47, fig. 5 (type).

One, 58 mm., Villavicencio, 1931. Depressed pectoral with filament, reaches 4 times to ventral. Dark spots on body and fins all apparently less numerous and more inconspicuous than shown in the figure Eigenmann publishes.

Pygidium knerii (Steindachner)

Trichomycterus knerii Steindachner, Sitzs. Akad. Wiss. Wien, vol. 86, pt. 1, 1882, p. 81, pl. 5, figs. 1-a (type locality, Canelos, Ecuador).

Pygidium kneri Eigenmann, Mem. Carnegie Mus., vol. 7, no. 1, Dec. 1915, p. 314, pl. 46, figs. 1-2 (copies Steindachner; Barrigona).

One, 233 mm., Rio Ocoá, Acacia Island, 1931. An obscure slightly darker median predorsal streak, as well as an axial one on each side of body.

Four, 138 to 217 mm., Villavicencio, 1931. Depth $6\frac{3}{5}$ to $7\frac{3}{5}$; head $5\frac{2}{5}$. Eye 10 to $10\frac{1}{2}$ in head. D. III, 6, I or III, 7, I; A. III, 5, I or III, 6, I.

Pygidium nigromaculatum (Boulenger)

Trichomycterus nigromaculatus Boulenger. Ann. Mag. Nat. Hist. London, ser. 5, vol. 19, 1887, p. 349 (type locality, Colombia).

Pygidium nigromaculatum Eigenmann, Mem. Carnegie Mus., vol. 7, no. 5, Sept. 1918, p. 317, pl. 49, fig. 5 (Colombian localities).

Two, 83 to 100 mm., Jericó, 1930. All show similar though much larger and less numerous spots than in Eigenmann's figure. Pectoral with filament reaches $2\frac{3}{5}$ to $2\frac{4}{5}$ to ventral.

Pygidium bogotense Eigenmann

Pygidium bogotense Eigenmann, Indiana Univ. Studies, no. 16, Dec. 23, 1912, p. 18 (type locality, Châpinero; Madrid); Mem. Carnegie Mus., vol. 7, no. 5, Sept. 1918, p. 315, pl. 49, figs. 3-4 (types; plains of Bogota northward).

Two, 70 to 73 mm., Jericó, 1930. Pectoral with filament reaches $2\frac{1}{8}$ to $2\frac{1}{2}$ to ventral. Smaller specimen with more or less blackish axial streak, and larger specimen with spots larger and more like Eigenmann's figure 4.

Pygidium striatum Meek and Hildebrand — Figures 21 (head below) and 22.

Pygidium striatum Meek and Hildebrand, Field Mus. Publ., no. 166, Zool. ser. vol. 10, Dec. 1913, p. 78 (type locality, Rio Cauca, Tuyra basin, Panama).—Eigenmann, Mem. Carnegie Mus., vol. 7, no. 5, Sept. 1918, p. 321 (Colombian localities).—Hildebrand, Field Mus. Publ., no. 425, Zool. ser. vol. 22, no. 4, Sept. 28, 1938, p. 246 (reference).

One, 76 mm., San Gil, 1931.

Depth $5\frac{1}{5}$; head $5\frac{1}{2}$, width $1\frac{1}{8}$. Eye $3\frac{1}{2}$ in interorbital, which is $3\frac{1}{2}$ in head. Snout slightly less than postorbital. Maxillary barbel $\frac{9}{10}$ of head. D. I, 6, I, origin little before vent. A. I, 5, I, begins opposite first $\frac{2}{5}$ of dorsal length, space from base of last ray to caudal $5\frac{2}{5}$ in total. Pectoral with filament reaches $2\frac{3}{4}$ to ventral, last not quite reaching vent. Back light olive, maize yellow on belly and under surfaces. Obscure and slightly darker band from opercle to middle of caudal base. Back, sides, and tail also with obscure or indistinct numerous darker spots.

CETOPSIDAE

Hemicetopsis othonops Eigenmann

Hemicetopsis othonops Eigenmann, Indiana Univ. Studies, no. 16, Dec. 23, 1912, p. 17 (type locality, Girardot; Apulo; Cauca near Cali); Mem. Carnegie Mus., vol. 9, no. 1, Oct. 1922, p. 56, pl. 3, fig. 1 (photograph) (types).

One, 130 mm., from the upper Magdalena River, sent by Brother Apolinar Maria. Color in life golden-yellow.

Eigenmann's account of this species is imperfect. He lists 69 specimens with the dimensions of the type as 120 mm. and refers to one other specimen as 93 mm. His photograph fails to reveal the barbels clearly, which

are unnoticed in his descriptions and other details as fin rays, etc., are equally poor.

ASTROBLEPIDAE

Astroblepus grixalvii Humboldt

Four, 70 to 80 mm., Choachi.

Astroblepus chotae (Regan)

Arges chotae Regan, Trans. Zool. Soc. London, vol. 17, pt. 3, 1904, p. 313, pl. 21, fig. 5 (type locality, Chota Valley, northern Ecuador).

Astroblepus chotae Eigenmann, Mem. Carnegie Mus., vol. 9, no. 1, Oct. 1922, p. 54, pl. 7, fig. 5 (Western Ecuador; both slopes eastern Andes of Colombia).

Two, 120 to 121 mm., Fusagasugá. Depth $4\frac{3}{7}$ to 5. Male with long anal papilla and the greatly extended pectoral reaching beyond middle of depressed ventral or almost opposite vent. Male with adipose fin slightly lower than in female. Both with 5 or 6 irregular transverse rows of blackish spots on caudal rays and base with dark band. Dorsal with 7 spots on spine and 3 to 5 less distinctly on rays. Body well marked with obscure blackish blotches.

One, 94 mm., Sasaima, 85 kilometers northwest of Bogotá; six, 63 to 105 mm., Ceguerza, Rio Negro on trail to Villavicencio, 1931; one, 88 mm., five miles from Villavicencio, 1932; two, 72 to 78 mm., Aug. 1931. Yellow contrasted and variegated with large dark blotches, especially dark at anal and caudal bases. Caudal with long upper and lower slender filamentous points.

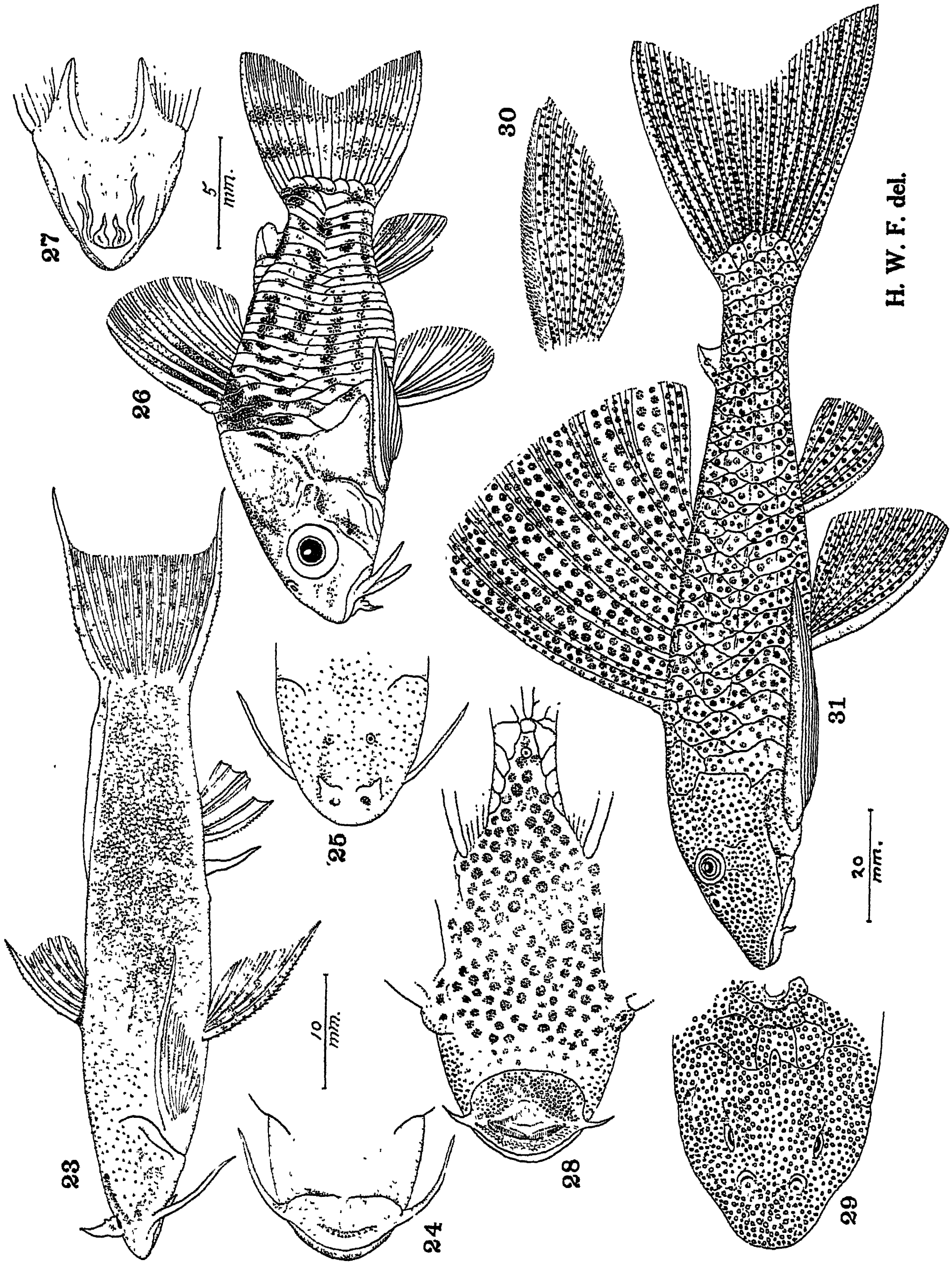
Astroblepus caquetae new species

Figures 23 (lateral view), 24 (head below), and 25 (head above).

Depth $4\frac{1}{3}$ to $4\frac{3}{4}$; head $3\frac{3}{5}$ to 4, width $1\frac{1}{10}$ in its length, which may vary to $1\frac{1}{10}$ in its width. Snout (in profile) $1\frac{3}{5}$ to $1\frac{3}{4}$ in head; eye very small, $2\frac{1}{2}$ to 3 in interorbital, edges not free; mouth inferior, width $2\frac{1}{8}$ to $2\frac{1}{5}$ in head; buccal disk broad, papillate; maxillary barbel reaches little beyond pectoral origin; teeth bifid, small, yellowish or brassy brown, 20 in transverse row above; interorbital $3\frac{3}{5}$ to $4\frac{1}{4}$ in head, level; nostrils large, separated by rather long, pointed, cutaneous flaps. Gill opening lateral, separated by wide isthmus.

Head above and predorsal covered more or less with fine feeble villous points. Edges of fin spines with minute asperities. Most of skin on trunk and tail with fine weak granules. Lateral line not very distinct, axial, in row of 24 + 2 short horizontal tubes.

D. I, 5, flexible spine $1\frac{1}{8}$ to $1\frac{1}{5}$ in head; interdorsal space greater than base of dorsal fin; long low adipose fin begins before vent and continuous with caudal behind, though slightly notched without evident spine; A. I, 5, spine flexible, $1\frac{3}{4}$ to $1\frac{7}{8}$ in head; least depth of caudal peduncle $1\frac{3}{4}$ to 2; caudal with hind edge straight or truncate, upper and lower spines flexible and little exserted, fin $2\frac{1}{2}$ to $3\frac{1}{6}$ in rest of fish; pectoral reaches $1\frac{2}{5}$ to $1\frac{3}{4}$ to anal papilla, fin rays I, 8; ventral I, 5, fin reaches $1\frac{1}{5}$ to $1\frac{1}{2}$ to anal. Long anal papilla nearly half of head.



FIGS. 23–25.—*Astroblepus caquetae* new species.

FIGS. 26–27.—*Corydoras caquetae* new species.

FIGS. 28–31.—*Plecostomus argus* new species.

Color in alcohol brown, without definite markings, paler below. Obscure and indistinct dark axial band along lateral line. Blackish streak forward from eyes to and expanded behind nostrils, also somewhat along lower side of head. Fins pale brown, deeper brown basally and with obscure brown spots on outer part of fins.

A.N.S.P., no. 70506. Florencia, Rio Orteguasa, Colombia. Length 65 mm. 1932. Type.

A.N.S.P., nos. 70507 and 70508. Same data as type. Length 53 to 60 mm. Paratypes.

Related to the preceding species, *A. chotae*, which appears to differ in having the head $4\frac{1}{2}$ ($4\frac{1}{3}$ in Regan's figure), interocular width little greater than space from eye to hind nostril, barbel reaches beyond gill opening (not reaching pectoral origin in figure), ventral inserted below first dorsal rays (below base of spine in figure) and reaches little beyond vent ($1\frac{2}{5}$ to anal origin in figure), predorsal space $2\frac{3}{4}$ in standard length, space from base of last anal ray to caudal base $6\frac{1}{3}$ in total length (7 on figure, $5\frac{1}{5}$ in standard length), adipose fin figured $2\frac{3}{4}$ in standard length, color grayish indistinctly marbled with darker. *Astroblepus nicefori* Myers[11] differs with the depth slightly over 6, low little developed adipose fin originating over the anal origin, short maxillary barbel not reaching gill opening, dorsal with spine and 6 rays, color light brown mottled with dark, and length 72 mm.

(Named for Caquetá.)

CALLICHTHYIDAE

Corydoras caquetae new species Figures 26 and 27 (head below).

Depth $2\frac{2}{5}$; head 3, width slightly greater than head length. Snout (in profile) 3 in head, tip formed well below level of eye; eye $2\frac{2}{3}$, subequal with snout, $1\frac{1}{2}$ in interorbital; mouth small, inferior, with short cleft; lips rather fleshy; pair of fleshy barbels, not reaching gill opening; pair of short mental barbels, with broad bases; interorbital 2 in head, broadly convex; occipital fontanel long as snout, large, length $1\frac{1}{2}$ in space to dorsal origin; cheek exposed, naked. Gill opening lateral, little larger than eye.

Lateral plates 23 to caudal base and 1 in transverse row of caudal plates. Coracoids extend back not quite as far as hind end of humeral plate; interspace between coracoid ridges little greater than eye diameter, bones not quite surrounding pectoral bases. Skin on cheek, under surface of head, chest and belly smooth.

D. I, 7, smooth spine as depressed not reaching adipose fin, long as head; adipose fin $3\frac{2}{5}$ in head; A. I, 6, slender spine $2\frac{1}{6}$, first ray $1\frac{3}{5}$; least depth of caudal peduncle $1\frac{2}{3}$; caudal $2\frac{1}{2}$ in rest of fish, well emarginate behind; ventral I, 5, spine rather flexible, fin $1\frac{1}{8}$ in head and not quite reaching anal; pectoral reaches $1\frac{2}{5}$ to anal, rays I, 7, spine straight, with 16 close-set serrae along outer edge and little fewer along inner edge.

Color in alcohol brown, with under surfaces uniform. Top of head dark brown above eye and dark shading on postocular region and opercles. Iris

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[11] Copeia. no. 3. Oct. 7. 1932, p. 137 (type locality, Sonsón, Antioquiá, in Cauca basin, Colombia).

gray. On body irregular and variable brown spots, more or less as 4 longitudinal rows, with 2 on each series of body plates. Dorsal with blackish vertical band on its front half, which is reflected down on back. Caudal with 3 dark brown transverse bands, outermost little evident. Also transverse darker band across caudal base. Anal with dark postero-median blotch.

A.N.S.P., no. 70509. Florencia, Rio Orteguasa, Colombia. Length 36 mm. 1932. Type.

Known chiefly by its distinctive coloration. Dorsal with first 3 rays and membranes black.

(Named for Caquetá.)

LORICARIIDAE

Plecostomus argus new species

Figures 28 (body below), 29 (head above), 30 (right pectoral from above), and 31 (lateral view).

Depth $4\frac{3}{4}$; head $5\frac{1}{3}$, length of head $1\frac{5}{7}$ in its width. Snout (in profile) $1\frac{1}{10}$ in head, broadly depressed; orbit elevated, 5 in head, 4 in snout, 3 in interorbital; mouth width $1\frac{7}{8}$ in head; buccal disk width $1\frac{1}{10}$ in head, with very broad papillate lower lip, with papillae small, crowded and more numerous marginally, also with small cirrus each side as long as eye; about 25? (damaged) small, slender, terminally curved and bifid teeth each side above, and about 35 each side below; interorbital $1\frac{3}{5}$ in head, depressed, each supra-orbital posteriorly little elevated. Gill opening twice orbit, largely below hind part of eye.

Scutes 25 + 2 in lateral series; 4 transversely between dorsal and ventral bases, 3 predorsal. Scutes on body each with longitudinal keel ending in small spine. Under surface of head covered with smooth skin, sides alone asperous. Broad band of weak asperities across thorax and few lateral small clusters along each side. Occipital plate with pointed extension behind. Basal caudal scutes moderately large and obtuse.

D. I, 7, fin very large, depressed back reaches scute at front of adipose fin, flexible spine finely asperous and length $2\frac{4}{5}$ in fish without caudal, first ray $2\frac{3}{5}$; adipose fin 3 in snout, with compressed asperous spine; A. I, 4, fin $1\frac{1}{10}$ in head; least depth of caudal peduncle 2; caudal $2\frac{1}{4}$ in rest of fish, emarginate, upper lobe little shorter; pectoral $2\frac{3}{4}$, rays I, 7, compressed rigid spine broad and finely asperous; ventral rays I, 5, with broad compressed asperous spine terminally flexible, length $3\frac{5}{7}$.

Color in alcohol brown, marked most everywhere with innumerable small darker to blackish brown spots. On head above and on sides very small, crowded or dense, likewise on fins. On dorsal fin spots mainly in 2 variable series on membranes, though those on rays irregular and may encroach. On back and sides of body spots more obscure, though several or more on a scute. On under surface of head, breast and belly spots largest; close set and mostly dark and distinct. Eyes grayish. Dorsal, caudal and pectoral more or less dark to blackish gray terminally.

A.N.S.P., no. 70510. Villavicencio, Rio Meta basin, Colombia. 1931. Length 167 mm. Type.

Only the type obtained. Apparently related to *Plecostomus tenuicauda* Steindachner[12] but differing in the caudal peduncle depth 3 in its length (4 in *P. tenuicauda*), 3 plates on border of supra-occipital (5 in *P. tenuicauda*), width of first plate behind occipital equals its length ($2\frac{1}{3}$ in its length in *P. tenuicauda*) preorbital length $\frac{4}{5}$ of orbit (equals orbit in *P. tenuicauda*), postocular discontinuous after third lateral plate (figured as continuous below dorsal fin in *P. tenuicauda*), 20 black spots on membranes of median caudal rays (10 spots shown in *P. tenuicauda*), depressed dorsal reaches scute before adipose fin (reaches 2 scutes before adipose fin in *P. tenuicauda*), belly marked with black spots (not shown in *P. tenuicauda*).

(*argus*, the hundred eyes of Argus, with reference to the innumerable dark spots.)

Hemiancistrus niceforoi new species

Figures 32 (body below), 33 (head above), 34 (right pectoral from above), and 35 (lateral view).

Depth $4\frac{7}{8}$; head $4\frac{1}{2}$, length $1\frac{1}{3}$ in its width. Snout (in profile) $1\frac{1}{6}$ in head, broadly depressed; orbit elevated, $5\frac{4}{5}$ in head, $4\frac{2}{3}$ in snout, $3\frac{1}{2}$ in interorbital; mouth width $1\frac{1}{2}$ in head; buccal disk width $1\frac{1}{5}$ in head, with papillate lips, lower broader and papillae smaller and more numerous marginally, also small cirrus each side long as orbit; 35 small, slender, close-set, terminally curved and simple teeth each side above and similar number below each side; interorbital $1\frac{4}{5}$ in head, depressed, with broad ridge rising up to supra-occipital. Gill opening twice orbit, largely below hind part of eye.

Scutes 25 + 1 in lateral series; 4 transversely between dorsal and ventral bases, 3 predorsal. Scutes on body each with a longitudinal keel ending in a small spine. Under surface of head with asperous lateral area each side, largely smooth medially. Greater part of thorax and belly below finely roughened or asperous, at least medially. Occipital plate with pointed extension behind. Median basal caudal scutes largest.

D. I, 7, fin very large, depressed back reaches adipose fin, spine finely asperous and terminally flexible, length $2\frac{2}{3}$ in fish without caudal, first ray $2\frac{1}{3}$; adipose fin $2\frac{3}{5}$ in snout, with compressed asperous spine; A. I, 4, spine $1\frac{3}{4}$ in head; least depth of caudal peduncle $2\frac{1}{8}$; caudal 2 in rest of fish, well emarginate, upper lobe slightly shorter; pectoral 3, rays I, 7, broad, rigid, spine compressed, finely asperous or denticulate; ventral rays I, 5, with broad compressed spine terminally flexible, length $3\frac{1}{2}$.

Color in alcohol brown. Head above and on sides marked with very small close-set dark brown spots. On body much larger dark brown spots appearing more or less along borders of scales. Breast, thorax, and belly also with larger rounded dark spots, crowded and well contrasted. On under surface of tail each scute with rather large dark spot. Eyes grayish.

A.N.S.P., no. 70511. Florencia, Rio Orteguasa, Colombia. Length 213 mm. 1932. Type.

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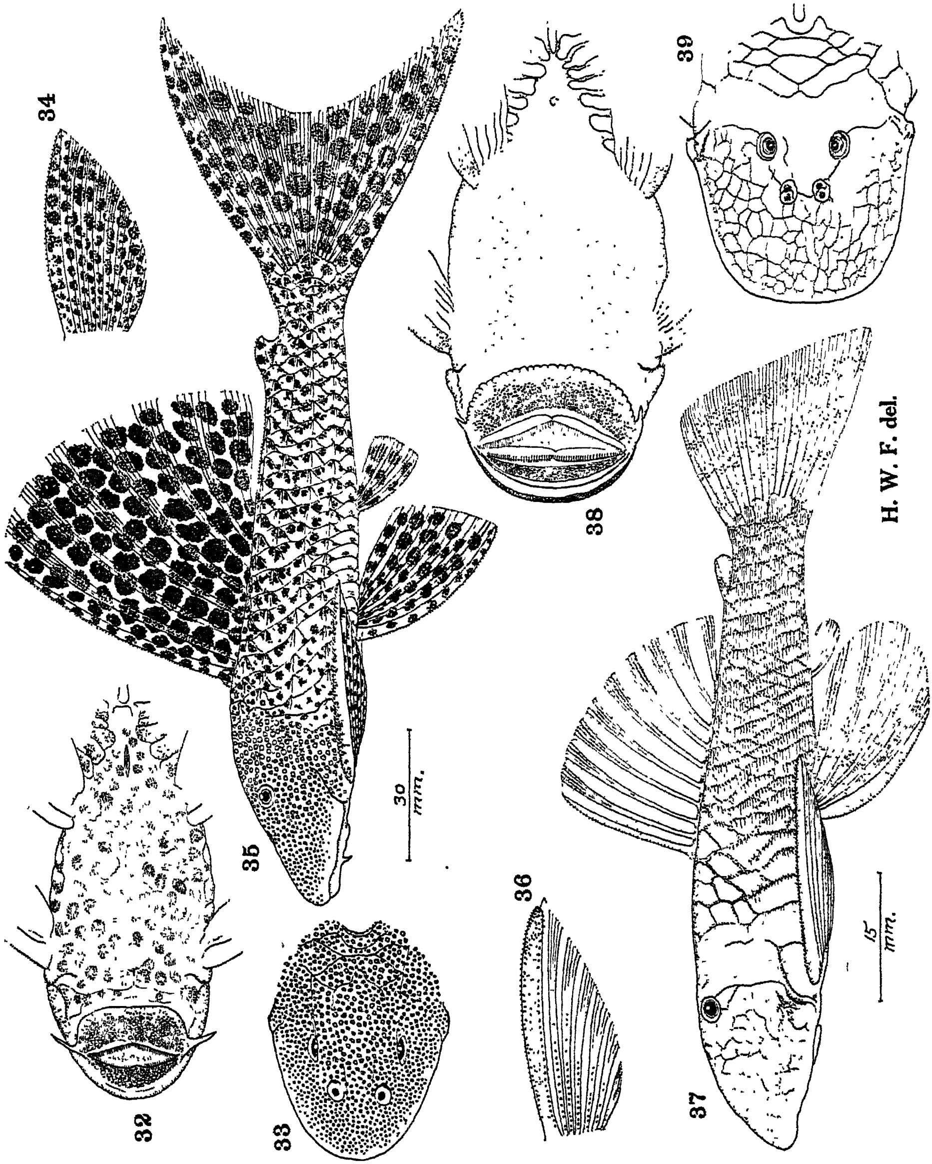
[12] Denks. Akad Wiss. Wien. vol. 39, 1879, p. 40, pl. 6 (type locality, Rio Magdalena, Colombia).



FIGS. 32–35.—*Hemiancistrus niceforoi* new species.
FIGS. 36–39.—*Hemiancistrus platyrhynchus* new species.

Resembles *Hemiancistrus wilsoni* Eigenmann [13] which differs in the mandible 3 to $3\frac{3}{5}$ in "interopercle" (erroneously stated by Eigenmann) as interorbital was apparently his intention ($7\frac{1}{2}$ in *H. niceforoi*), occipital with high keel (low broad ridge in *H. niceforoi*) and median caudal rays $1\frac{2}{5}$ in lower rays ($1\frac{7}{8}$ in *H. niceforoi*). The drawing of the type shows the post-ocular dark spots much larger or about 5 irregularly back (8 in *H. niceforoi*), also the caudal emarginate behind but with 12 spots on the middle rays (only 5 in *H. niceforoi*). In Eigenmann's photographic reproduction 5 the dark spots are more closely set than in *H. niceforoi* and the buccal disk slightly narrower. Both figures indicate smaller and more numerous spots on the fins.

(Named for Brother Nicéforo Maria.)

Hemiancistrus platyrhynchus new species

Figures 36 (right pectoral from above), 37 (lateral view), 38 (head and trunk below), and 39 (predorsal above).

Depth $4\frac{4}{5}$ to 5; head 4 to $4\frac{1}{8}$, length of head $1\frac{2}{3}$ to $1\frac{3}{4}$ in its width. Snout (in profile) 1 to $1\frac{1}{5}$ in head, very broad, depressed, as seen from above profile widely convex; eye $5\frac{1}{2}$ to $5\frac{7}{8}$ in head, well elevated, $5\frac{1}{4}$ to 6 in snout, $2\frac{1}{8}$ to $2\frac{1}{5}$ in interorbital; mouth width 1 to $1\frac{1}{8}$ in head; buccal disk width $1\frac{1}{4}$ to $1\frac{1}{3}$ in head width, with papillate lips, lower broader and papillae smaller and more numerous marginally, also small cirrus each side less than eye; teeth very minute, close set, truncate, 40 or 41 each side above and 60 to 65 each side below; interorbital $2\frac{7}{8}$ to 3 in head, depressed or nearly level and like rest of top of head evenly convex. Gill opening small, $1\frac{1}{2}$ times orbit, mostly below hind part of eye.

Scutes 23 + 1 in lateral series; 4 transversely between dorsal and ventral bases, 3 predorsal. Under surface of head, chest, and belly covered with smooth skin. Occipital plate with broad obtuse angle behind. Basal caudal scutes moderately large.

D. I, 9 or I, 8, spine $1\frac{1}{10}$ to $1\frac{1}{4}$ in head, flexible, asperous; adipose fin $3\frac{1}{8}$ to $3\frac{4}{5}$; A. I, 3, spine variably shorter than fin, length of which is $2\frac{1}{2}$ to $3\frac{4}{5}$ in head; least depth of caudal peduncle $2\frac{1}{8}$ to $2\frac{1}{5}$; caudal $2\frac{3}{4}$ to $2\frac{4}{5}$ in rest of fish, upper spine but little over $\frac{1}{2}$ length of lower spine and hind edge oblique back and down; pectoral $2\frac{3}{4}$ to 3, rays I, 6, spine rigid, broad, compressed, finely asperous; ventral rays I, 5, spine arched, terminally flexible, asperous and fin 3 to $3\frac{3}{4}$.

Color in alcohol dull olive-brown, under surface paler or light grayish. Dorsal with membranes grayish. Caudal brownish and with 4 dark parallel gray-brown transverse bands, though all inclined and parallel with hind caudal edge. Paired fins brown, with indistinct and obscure brown spots on rays. Iris gray.

A.N.S.P., no. 70512. Florencia, Colombia. Length 95 mm. 1932. Type.

A.N.S.P., nos. 70513 to 70515. Colombia, without definite locality. 1931. Length 25 to 82 mm. Paratypes. Most uniform brown. Some vary with

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[13] Proc. Amer. Philos. Soc., vol. 56, 1917, p. 678 (type locality, Truando, Atrato, Colombia); Mem. Carnegie Mus., vol. 9, no. 1, Oct. 1922, p. 74, pl. 9, fig. 5 (photograph of ventral view), pl. 10, fig. 1 (type).

obscure markings, an occasional specimen with 3 obscure transverse darker bands on the caudal or a submarginal diffuse dark grayish band, and in addition sometimes a faint gray blotch below middle of each ray.

This species is known chiefly by its broadly rounded snout, and other details as fin counts and proportions in combination.

(πλατὺς broad + ῥύγχος snout.)

Ancistrus caucanus new species — Figures 40 (head and belly below), 41 (head above), 42 (right pectoral above), and 43 (lateral view).

Depth $4\frac{2}{3}$; head 4, length $1\frac{4}{7}$ in its width. Snout (in profile) $1\frac{1}{3}$ in head, margin all around with soft smooth skin; eye $4\frac{1}{2}$, $3\frac{1}{5}$ in snout, $2\frac{1}{2}$ in interorbital; mouth width $1\frac{1}{2}$ in head; buccal disk width $1\frac{1}{3}$ in head width, with well papillate lips, lower broader and papillae smaller, more numerous and crowded marginally, also small cirrus each side greatly less than eye; teeth 28 to 30 each side above and as many each side below, truncate to bifid, terminally small, slender, close set and ends curved; interorbital $1\frac{4}{5}$ in head, depressed to nearly level. Interopercle with 13 hooked spines, posterior longest, all depressible within deep groove opposite eye and just before gill opening. Gill opening small, but little longer than eye, mostly below hind part of eye.

Scutes 25 + 1 in lateral series; 4 transversely between dorsal and anal bases, 3 predorsal. Under surface of head, chest, and belly covered with smooth skin. Occipital plate truncate behind, bordered behind by 4 plates though median 2 closely approximated.

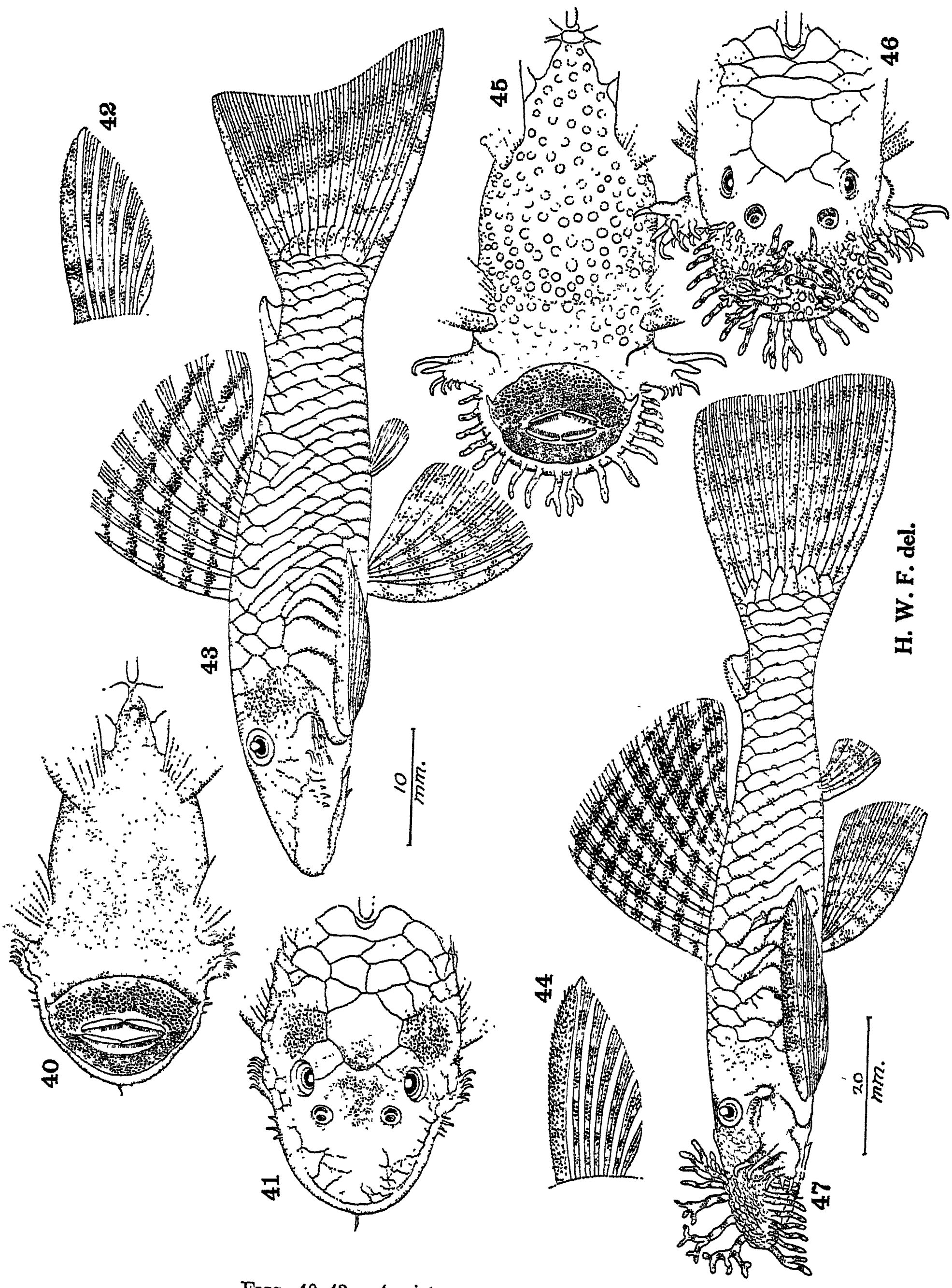
D. I, 7, slender, spine rather pungent and asperous, first branched ray slightly exceeds head; adipose fin 3 in head, with compressed asperous spine; A. I, 3, length $2\frac{1}{2}$; least depth of caudal peduncle 2; caudal $2\frac{2}{5}$ in rest of fish, upper lobe little shorter than lower, with hind fin edge oblique and slightly emarginate, upper and lower spines slender and finely asperous; pectoral $3\frac{1}{3}$, ray I, 6, spine compressed, finely asperous; ventral I, 5, spine well compressed, little arched and finely asperous, fin $3\frac{1}{3}$.

Color in alcohol brown, but little paler below where are some obscure darker and irregular cloudings. Eye gray. Dorsal brownish, with 5 longitudinal blackish brown bands, uppermost palest. Other fins all brownish. Caudal with 4 to 6 dark brown bands, somewhat irregular or as spots, darker on rays, and parallel more or less with hind edge of caudal. Pectoral with 4 transverse bands of blackish brown and 5 bands across ventral.

A.N.S.P., no. 70516. Sonsón, Cauca River basin, Colombia. 1931. Length 68 mm. Type.

Characterized by having all the fins marked with dark or blackish bands and crossing the spines and rays where they are interrupted, 5 on dorsal, 5 on caudal, and 4 on each of paired fins. Some obscure dark spots on head above, several in the interorbital large and conspicuous. Naked belly pale and clouded. Apparently related to *Ancistrus chagresi* Eigenmann and Eigenmann, but the figures of Regan [14] show different occipital

[14] Trans. Zool. Soc. London, vol. 17, pt. 3, 1904, p. 256, pl. 14, fig. 7.



FIGS. 40–43.—*Ancistrus caucanus* new species.
FIGS. 44–47.—*Ancistrus lineolatus* new species.

scalation. *A. chagresi* shows the interorbital width $2\frac{2}{5}$ in the predorsal length ($3\frac{1}{8}$ in *A. caucanus*), preorbital plate equals eye (less than eye in *A. caucanus*), longer interopercular spines extend back opposite hind edge of interopercle and 10 in number (spines 13 and short in *A. caucanus*), internasal width slightly over 2 in interorbital width ($1\frac{7}{8}$ in *A. caucanus*) and mandibular ramus $2\frac{3}{7}$ to $3\frac{1}{5}$ in interorbital (2 in *A. caucanus*).

(Named for the Rio Cauca.)

Ancistrus triradiatus Eigenmann

Ancistrus triradiatus Eigenmann, Proc. Amer. Philos. Soc., vol. 56, 1917, p. 680 (type locality, Quebrada Cramalote, Villavicencio; Barrigon, Colombia); Mem. Carnegie Mus., vol. 9, no. 1, Oct. 1922, p. 224, pl. 12, fig. 8 (photograph), pl. 13, figs. 3-4 (types).

Thirteen, 40 to 125 mm., Villavicencio, 1931. The largest differs somewhat from the 2 drawings published by Eigenmann in having 8 large suprarostral tentacles, his drawings showing but 6. The blackish spots on the fin rays are also all more regular in my specimen. My small specimens are greatly like his figure 8. The smallest show 3 or 4 black longitudinal bands on the dorsal, increasing to 5 in the largest, with the apex of the fin white, also the upper and lower tips of the caudal. In the smallest nearly the entire hind edge of the caudal fin is white.

Ancistrus lineolatus new species

Figures 44 (right pectoral above), 45 (belly and head below), 46 (predorsal above), and 47 (lateral view).

Depth $5\frac{2}{5}$; head $4\frac{1}{5}$, length $1\frac{1}{5}$ in its width. Snout (in profile) $1\frac{1}{3}$ in head, broadly with soft and finely wrinkled skin; eye 5, 4 in snout, $3\frac{1}{3}$ in interorbital; mouth width $1\frac{4}{5}$ in head; buccal disk width subequal with head, with well papillate lips, upper with finer and minute papillae, internally with large ones submarginally, with lower broader lip with very numerous papillae, small and minute submarginally, also small cirrus each side greatly less than eye; teeth about 50 each side above and 38 each side below, very fine, slender, close set, ends little curved and bifid; interorbital $1\frac{1}{2}$ in head, depressed to nearly level. Interopercle with 7 large principal spines, ends hooked, longest $1 + \frac{1}{2}$ eye diameters, also 7 tentacles present. Gill opening opposite eye, long as $1 + \frac{1}{4}$ eye diameters.

Scutes $24 + 1$ in lateral series; 4 transversely between dorsal and ventral bases, 3 predorsal. Under surface of head, chest, and belly covered with smooth skin. Occipital plate truncate behind, bordered by 3 plates behind. Snout with more than outer half furnished with marginal fringe of rather long fleshy tentacles, median pair forked; on upper surfaces median row of 4 long branched tentacles, and 3 simple shorter ones on left side, also 2 on right side; whole front surface of snout with wrinkled and grooved skin.

D. I, 7, slender spine finely asperous and terminally flexible, length $3\frac{4}{5}$ in fish without caudal, first ray $3\frac{2}{3}$; adipose fin $2\frac{4}{5}$ in head, compressed spine finely denticulate above and terminally; A. I, 4, fin 2; least depth of caudal peduncle $2\frac{1}{4}$; caudal $2\frac{2}{3}$ in rest of fish, upper lobe little shorter, hind edge slightly inclined down and back; pectoral 3, with clavate compressed spine,

finely denticulated, especially terminally, rays I, 6; ventral rays I, 6, broadly compressed spine finely denticulate, length $3\frac{3}{4}$.

Color in alcohol brown above, with very obscure dark shades. Tentacles all pale with brown spots and naked skin on snout brown with white spots. Whole under surface of head, breast, and belly with skin brown, marked with numerous white spots. Iris gray. Dorsal brownish, with 5 to 8 dark brown longitudinal bands, each emphasized as dark blotch on each ray, giving appearance of membranes paler and all crossed by longitudinal white lines. Adipose fin with several dark blotches. Anal with 3 broad dark bands. Caudal pale, crossed by 7 parallel transverse bands. Pectoral with 6 transverse brownish bands and ventral with 8.

A.N.S.P., no. 70517. Florencia, Rio Orteguasa, Colombia. Length 121 mm. 1932. Type.

Only the type obtained. Differs from *A. triradiatus* in the less elaborately branched tentacles. The coloration is also quite different, as the dark spots on the rays of the dorsal are all smaller and consequently the pale bands broader though regular, and not with the irregular inclined pattern shown in the drawing of the type as published by Eigenmann in 1922. In my specimens of *A. triradiatus* all the under surfaces are uniformly brownish, without any white spots. Eigenmann described the coloration of the body, including head and belly, with faint, roundish light spots and the dorsal with 5 series of comma-shaped black spots in broken series lengthwise of the fin.

(*lineolatus* with small or narrow lines; with reference to the white longitudinal lines on the dorsal.)

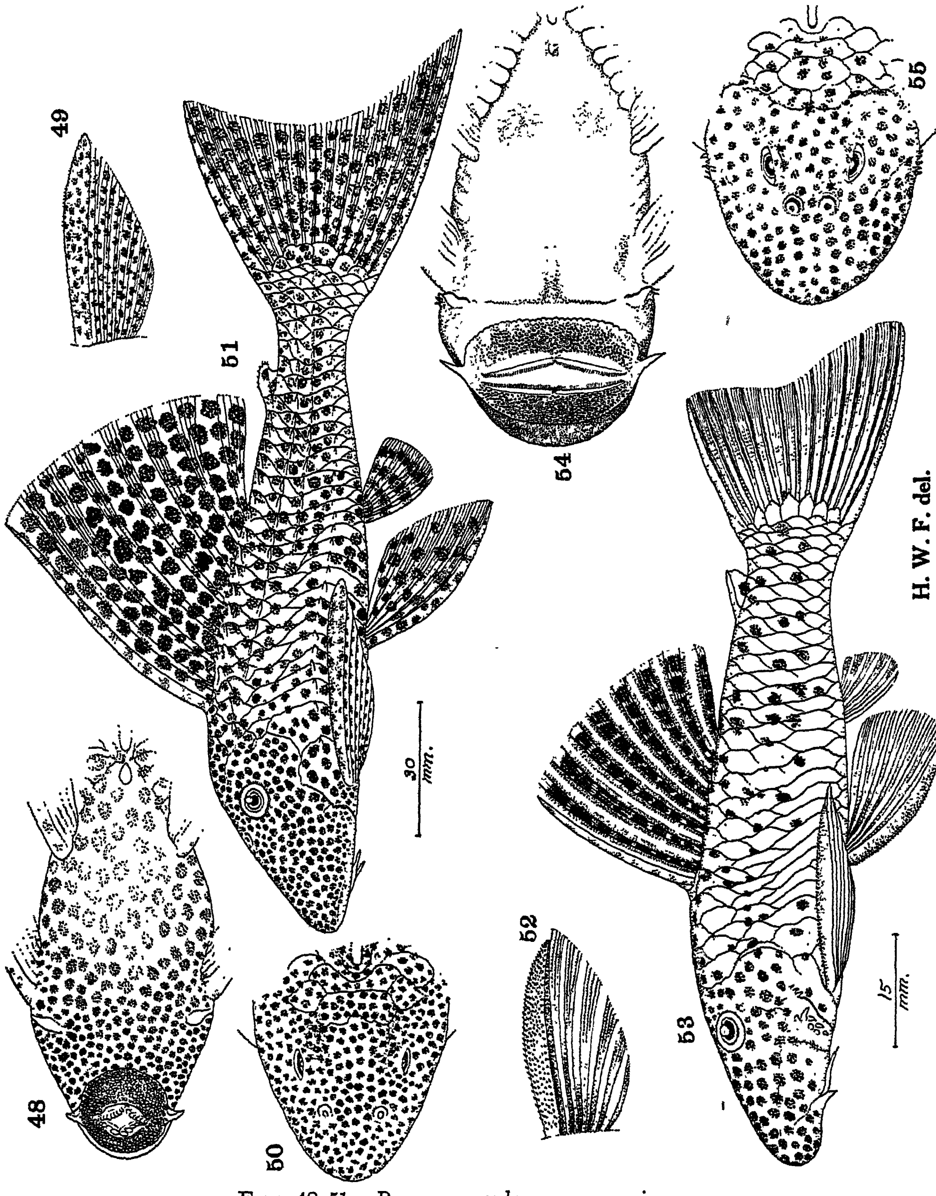
Panaque oculeus new species

Figures 48 (head and belly below), 49 (right pectoral above), 50 (head above), and 51 (lateral view).

Depth $3\frac{4}{5}$ to $4\frac{1}{4}$; head $4\frac{1}{2}$, length of head $1\frac{1}{5}$ to $1\frac{1}{4}$ in its width. Snout (in profile) $1\frac{1}{4}$ to $1\frac{1}{3}$ in head, convex, rather attenuated as seen from above; eye 4, 3 to $3\frac{2}{5}$ in snout, $2\frac{2}{5}$ to $2\frac{1}{2}$ in interorbital; mouth width $1\frac{4}{5}$ to $2\frac{1}{8}$ in head; buccal disk width $1\frac{2}{3}$ to $1\frac{3}{4}$, with small lateral cirrus each side greatly less than eye; both lips with papillate surfaces, on lower lip papillae large; teeth expanded, spatulate, 7 or 8 each side above and 8 or 9 each side below; interorbital $1\frac{1}{2}$ to $1\frac{2}{3}$ in head, little elevated convexly and with slight depression each side; interopercle only with a few small short denticles. Gill opening slightly over $\frac{1}{2}$ of interorbital space.

Scutes 28 + 1 in lateral line; 3 predorsal, with first largest and bordered behind by 3 scutes. Body with 4 spinescent keels and axial rows begin on ninth to twelfth scutes of lateral line course or before anal.

D. I, 7, spine slender, pungent, length $2\frac{2}{3}$ to $2\frac{1}{2}$ in fish without caudal; adipose fin $3\frac{1}{3}$ to 4 in head, compressed spine well arched; A. I, 4 or I, 3, fin $1\frac{3}{5}$ to 2; least depth of caudal peduncle $2\frac{1}{8}$ to $2\frac{1}{2}$; caudal $2\frac{1}{3}$ to $2\frac{2}{5}$ in rest of fish, upper lobe little shorter and hind edge emarginate; pectoral 3 to $3\frac{1}{8}$, rays I, 6, large compressed spine rigid and spinescent; ventral $3\frac{2}{5}$ to $3\frac{1}{2}$, rays I, 5, spine terminally flexible.



FIGS. 48–51.—*Panaque oculeus* new species.
FIGS. 52–55.—*Chaetostomus vagus* new species.

Color in alcohol brown, marked everywhere with innumerable dark brown to blackish brown spots. On head and pectoral fins spots smallest and most numerous. On dorsal spots largest, more or less irregular over fin rays, though greater than intervening pale interspaces. Spots arranged as 4 bands across anal.

A.N.S.P., no. 70518. Florencia, Rio Orteguasa, Colombia. Length 200 mm. 1932. Type.

A.N.S.P., nos. 70519 and 70520, same data as type. Length 135 to 176 mm. Paratypes.

A species distinctive in its variegated coloration. The interopercle is scarcely denticulate, as in *Panaque cochliodon* (Kner), also all the under surface covered with small granular scales. In quoting Natterer, Kner says the head as well as the crown is with sparse small round blackish spots and that the fins are sparsely spotted with black.

(*oculeus* eyed, with reference to the innumerable small dark spots.)

Chaetostomus thomsoni Regan

One, 160 m., Pensilvania on the western slope of the Magdalena River at 80 kilometers northeast of Manizales.

Chaetostomus vagus new species

Figures 52 (right pectoral above), 53 (lateral view), 54 (head and belly below), and 55 (head above).

Depth 4 to $4\frac{1}{2}$; head $3\frac{7}{8}$ to $4\frac{1}{8}$, length $1\frac{1}{4}$ to $1\frac{1}{3}$ in its width. Snout (in profile) $1\frac{1}{5}$ in head, broadly depressed and covered with soft skin broadly all around front border; eye 4 to $4\frac{1}{8}$, $3\frac{1}{3}$ to $3\frac{1}{4}$ in snout, $1\frac{1}{2}$ in interorbital; mouth width $1\frac{1}{4}$ to $1\frac{2}{5}$ in head; buccal disk width equals its length; lips broad, papillate, inner papillae smallest and more numerous above while outer lower smallest and most numerous, and small cirrus each side less than eye; teeth fine, slender, bifid, ends curved, 50? each side above and as many below; interorbital $2\frac{4}{5}$ in head, depressed, nearly level; short interopercular spines 5 or 6. Gill opening below eye, equals eye diameter.

Scutes 25 + 1 in lateral line; 5 between dorsal and ventral bases, 3 predorsal. Scutes all with more or less denticulate edges, though no keels. Under surface of head and belly entirely covered with smooth skin.

D. I, 8, spine $3\frac{1}{4}$ to $3\frac{1}{2}$ in fish without caudal; adipose fin $2\frac{7}{8}$ to $3\frac{1}{3}$ in head; A. I, 5, first ray 2; least depth of caudal peduncle $1\frac{7}{8}$ to 2; caudal $2\frac{3}{4}$ to $4\frac{1}{4}$ in rest of fish, upper lobe shorter and hind edge obliquely emarginate downward; pectoral 3, rays I, 6, spine compressed, rigid and well denticulated; ventral I, 5, large compressed spine denticulated and first ray equals head.

Color in alcohol brown, slightly paler or grayish on under surfaces. Head with many rather large dark spots above and on sides. Scattered large dark brown spots on body, more or less as 2 or 3 longitudinal series. Iris dark grayish. Dorsal with each ray in broad gray band, leaving narrow pale to whitish streak in middle of membrane and with 5 to 8 dark blotches, with very narrow whitish separating line. Other fins all more or less brownish, with each membrane of caudal marked with a gray streak between rays.

A.N.S.P., no. 70521. Florencia, Rio Orteguasa, Colombia. Length 122 mm. 1932. Type.

A.N.S.P., no. 70522. Same data as type. Length 90 mm. 1932. Paratype.

A.N.S.P., nos. 70523 to 70524. Villavicencio, Rio Meta basin, Colombia. 1931. Length 95 to 126 mm. Paratypes.

Apparently related to *Chaetostomus brevis* Regan[15] described from specimens reaching 200 mm. Green's lithograph published by Regan shows a uniformly shaded fish. The description differs widely in that it says sometimes a network of dark lines on the head and dorsal membranes usually blackish, but sometimes with a row of light spots in front of each ray. Anal rays I, 4 (I, 5 in *C. vagus*). The 2 Meta specimens do not differ in any way from the Amazonian, and though the coloration has faded it still reveals the dark spots and similar pattern.

(*vagus* a wanderer.)

HYPOCOLPTERUS new genus

TYPE.—*Hypocolpterus analis* new species.

Body moderately long, head and trunk depressed and tail compressed, with rather short deep caudal peduncle. Head large, greatly wider than long, greatly depressed, convex above, flattened below. Snout broad, covered with soft, smooth, though finely wrinkled to papillate skin, around a wide border both above and below. Eye moderate, falls nearer dorsal than end of snout. Mouth very broad, inferior, with broadly papillate lips, with cirrus each side. Dental plates with very fine, slender, closely set, uniform, hooked, bifid teeth. Interorbital and predorsal more or less flattened. Large hooked spines on retractile interopercle few and largely concealed in thick integument. Nostrils large, closer together than eyes. Gill openings lateral. Scutes large, finely asperous or denticulate, likewise fin spines. Under surface of head, chest, and belly smooth, unarmed. Dorsal moderate, with flexible spine and 8 rays. Adipose fin moderate. Anal large, long as dorsal height. Caudal moderate, with hind edge oblique down to longer lower lobe. Pectoral large, low, reaches near to middle of dorsal or ventral, with rigid clavate spine, more denticulate terminally. Ventral long as pectoral, reaches beyond anal base, long pointed spine flexible and with cutaneous edge posteriorly on each side, smaller and less developed along hind edge of each ray. Similar cutaneous flanges on front or long rays of anal.

A genus with great similarity to *Chaetostomus* and *Ancistrus*, but differing from either in the enlarged paired fins and anal, the cutaneous flanges on the ventral and anal spines and rays. In the broadly naked border of the snout, finely wrinkled to papillate though smooth, it approaches *Chaetostomus*.

(ὑπο below + κόλπος fold + πτερόν fin, with reference to the dermal fold along the ventral and anal spines.)

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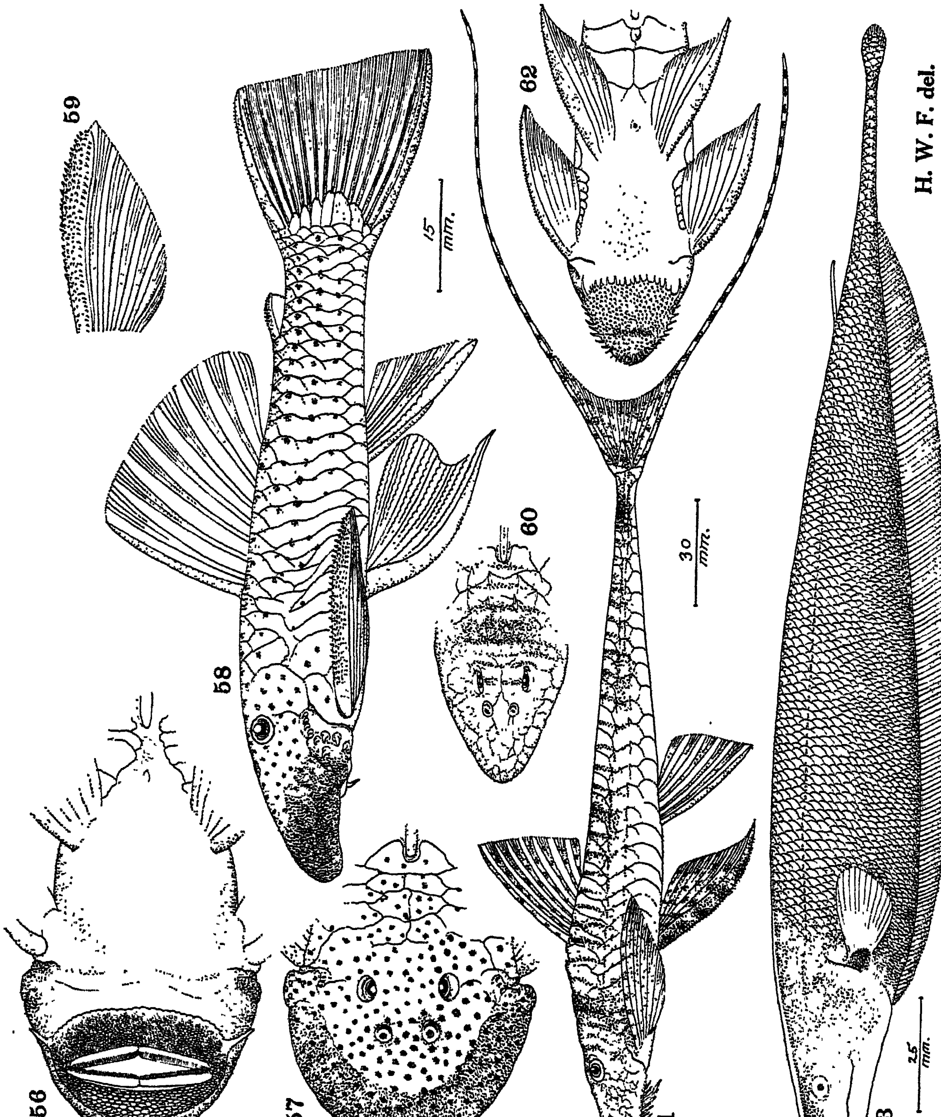
[15] Trans. Zool. Soc. London, vol. 17, pt. 3, 1904, p. 247, pl. 13, fig. 3 (type locality, Bomboiza and Zamora Rivers, Eastern Ecuador).



FIGS. 56–59.—*Hypocolpterus analis* new species.
FIGS. 60–62.—*Loricaria caquetae* new species.
FIG. 63.—*Sternarchus macrostomus* new species.

Hypocolpterus analis new species — Figures 56 (head and belly below), 57 (head above), 58 (lateral view), and 59 (right pectoral from above).

Depth $5\frac{1}{8}$; head $3\frac{7}{8}$, length of head $1\frac{1}{2}$ in its width. Snout (in profile) $1\frac{1}{8}$ in head, broadly depressed and widely with soft papillate or finely wrinkled skin all around front borders both above and below; eye 6, $5\frac{1}{2}$ in snout, $2\frac{1}{8}$ in interorbital; mouth width 2 in head width, or $1\frac{2}{5}$ in head length; buccal disk width $1\frac{1}{2}$ in head width; lips broadly papillated with upper anterior papillae largest and small ones posteriorly; small, crowded and numerous papillae all around border of lower lip, also on inner border; small lateral barbel on each side of buccal disk long as eye; teeth above 60 each side and 75 each side below, slender, fine, ends curved and bifid; interorbital $2\frac{1}{2}$ in head, level; interopercle with 5 rather large spines hooked forward. Gill opening equals $1 + \frac{1}{4}$ eye diameters, largely below hind part of eye.

Scutes $26 + 1$ in lateral line; 5 scutes between dorsal and ventral bases, 3 predorsal, bordered behind with 4 scutes. Row of scutes on caudal base much larger than those adjacent. Under surfaces of head, breast, and belly covered with smooth skin. Fin spines all more or less finely roughened, but few asperities on anal spine and those on upper surface of pectoral spine largest.

D. I, 8, spine flexible, first ray $1\frac{1}{10}$ in head; adipose fin $3\frac{1}{3}$, spine compressed, little arched; A. I, 5, spine and first ray with expanded cutaneous flange, less developed on second rays and little evident on others, first ray $1\frac{1}{10}$ in head; least depth of caudal peduncle $2\frac{1}{10}$; caudal $3\frac{1}{8}$ in rest of fish, upper lobes shorter, with hind edge sloping obliquely down and back; pectoral 3, rays I, 6, broad compressed rigid spine more denticulated on outer terminal portion; ventral rays I, 5, flexible pointed spine with cutaneous flange along outer edge and rays all with similar though shorter flanges.

Color in alcohol brown, paler on under surfaces of head, breast and belly, where also immaculate. Head on sides and above with innumerable small dark spots, smaller in interorbital and predorsal region. Body with 4 longitudinal rows of dark spots on back and side. Iris gray. Dorsal uniformly brown. Each membrane of caudal with dark longitudinal streak, darker posteriorly on fin. Lower fins uniformly pale brown.

A.N.S.P., no. 70525. Florencia, Rio Orteguasa, Colombia. Length 320 mm. 1932. Type.

Easily distinguished by its enlarged anal fin, which is equal in length with the pectoral.

(*analis* with reference to the large anal fin.)

Loricaria caquetae new species — Figures 60 (head above), 61 (lateral view), and 62 (head and belly below).

Depth 8; head $5\frac{2}{3}$ to $6\frac{1}{3}$, length of head $1\frac{1}{8}$ in its width. Snout (in profile) $1\frac{1}{6}$ to $1\frac{1}{4}$ in head; eye $4\frac{1}{5}$ to 5, $3\frac{2}{5}$ to 4 in snout, $1\frac{1}{4}$ to $1\frac{3}{5}$ in interorbital; posterior orbital notch shallow, $\frac{1}{4}$ of eye; buccal disk width $1\frac{2}{5}$ to $1\frac{1}{2}$ in head; lips moderate, lower much broader, hind edge fringed and fringe of longer tentacles on sides and anteriorly, where more numerous and abounding over most of upper lip; lower lip largely papillate, though papillae as moderate fleshy tentacles basally; larger posterior lateral tentacle

not especially prolonged, little less than interorbital; 2 or 3 teeth above each side and as many below each side, curved and amber-brown in color; mandibular ramus short, subequal with eye; interorbital $2\frac{7}{8}$ to $3\frac{1}{8}$ in head, depressed, broadly concave, supra-orbital without very distinct ridge each side. Gill opening mostly below hind part of eye, little longer than eye.

Scutes $30 + 1$ in axial lateral series and 3 well developed predorsals. Two lateral keels, approximating 2 scutes behind tip of depressed anal, and each ending in spine behind. Four parallel rows of spinescent keels on scutes before dorsal. Seven approximated small lateral scutes along each side of body under depressed pectoral fin. Belly and under surfaces covered with smooth skin, except for a few scattered small feeble scutes medially below pectoral bases. All fin spines spinescent, with spinules best developed on paired fins.

D. I, 7, spine $5\frac{1}{8}$ to $5\frac{1}{4}$ in fish without caudal; A. I, 5, spine $5\frac{4}{5}$ to $5\frac{7}{8}$; least depth of caudal peduncle $1\frac{2}{3}$ to $1\frac{4}{5}$ in eye; caudal emarginate, median rays $1\frac{2}{3}$ to $1\frac{3}{4}$ in head, with each upper and lower ray greatly prolonged filaments, upper $1\frac{1}{2}$ in rest of fish; pectoral $4\frac{1}{8}$ to $4\frac{3}{4}$ in fish without caudal, rays I, 6, slender compressed spine terminally flexible; ventral $4\frac{1}{6}$ to $4\frac{4}{5}$, rays I, 5, spine little more expanded than pectoral spine.

Color in alcohol brown above, under surfaces paler to whitish, especially breast and belly. On back 6 broad blackish blotches or saddles, best understood with reference to the accompanying figures. Also on head above and back each scute with dark transverse streak, first across interorbital. Iris gray. Buccal disk whitish. Lower front edge of snout pale gray, with some dark spots. Dorsal pale to whitish, each ray and spine with dark gray spots. Caudal very pale brownish, with slight light buff tint, on median rays in smaller example with base and median rays terminally blackish, though in type broken into several rows of spots on outer part of fin. In addition prolonged filamentous caudal rays pale brownish with gray or dark spots. Anal whitish with few pale gray spots anteriorly. Paired fins pale brownish with gray spots, most distinct and darker on spines.

A.N.S.P., no. 70526. Florencia, Rio Orteguasa, Colombia. 1932. Length 370 mm., of which upper caudal filament comprises 130 mm. Type.

A.N.S.P., no. 70527. Same data as type. Length 308 mm., of which caudal filament above comprises 160 mm.

Related to the Pacific Slope *Loricaria gymnogaster* Eigenmann and Vance[16] which differs in having the head depth at base of occipital 2 in its greatest width ($1\frac{2}{3}$ to $1\frac{4}{5}$ in *L. caquetae*), eye $1\frac{4}{5}$ in interorbital ($1\frac{1}{4}$ to $1\frac{3}{5}$ in *L. caquetae*), body width at base of last anal ray 4 in its distance from caudal base ($2\frac{7}{8}$ to $3\frac{1}{5}$ in *L. caquetae*), orbit without notch (small posterior notch present in *L. caquetae*), belly naked (with large median area and a few small simple denticles, little evident to touch, in *L. caquetae*), pectoral reaches $\frac{2}{3}$ in ventral (reaches $\frac{1}{3}$ in *L. caquetae*), greatly produced upper caudal rays over twice length rest of fish (not long as rest of fish in *L. caquetae*). In coloration *L. caquetae* is quite different, in the presence of

[16] Indiana Univ. Studies, no. 6, Dec. 23, 1912, p. 12 (type locality, Apulo, Colombia). —Eigenmann, Mem. Carnegie Mus., vol. 9, no. 1, Oct. 1922, p. 92, pl. 14, figs. 3-4 (photographs) (types).

dark transverse bands across each scute, a pattern of coloration in no way shown in Eigenmann's photographs. His description of the coloration is different, likewise the markings on the fins as far as shown or indicated.

(Named for Caquetá.)

Farlowella acus (Kner)

Acestra acus Kner, Denks. Akad. Wiss. Wien, vol. 6, 1854, p. 93, pl. 8, figs. 1, a, b (type locality, Caracas).

Farlowella acus Regan, Trans. Zool. Soc. London, vol. 17, pt. 3, 1904, p. 304 (Venezuela).—Eigenmann, Mem. Carnegie Mus., vol. 9, no. 1, Oct. 1922, p. 227 (Villavicencio, Barrigon, Rio del Fosca, Rio Tigurito).

Twelve, 87 to 178 mm., Guaicaramo, 1932. Varying in the plates on the belly. One specimen has only a median row of small scutes, while in several but 1 or 2 small median scutes are developed. All but smaller specimens with snout and sides of head with bristles, especially the snout. Most all with caudal creamy or pale reddish brown marked with 2 or 3 contrasted transverse black bands and the upper and lower extended rays with black spots. One 103 mm. long differs from the others in a slightly longer smooth snout and in having larger and fewer but differently arranged scutes on the under surface of the head and breast.

GYMNOTIDAE

Gymnotus carapo Linnaeus

Gymnotus carapo Linnaeus, Syst. Nat., ed. 10, pt. 1, 1758, p. 246 (type locality, in America).—Ellis, Mem. Carnegie Mus., vol. 6, no. 3, Sept. 1913, p. 117, text fig. 2 (outline head and trunk) (Guiana, Bolivia, Brazil, Trinidad, Guatemala).

From Villavicencio in 1931 two, 155 to 205 mm.; and in 1932 fourteen, 83 to 193 mm.

Sternopygus macrurus (Schneider)

Three, 142 to 208 mm., Villavicencio, 1931; four, 222 to 343 mm., Rio Ocoá, Atacio Island, 1931.

Sternarchus macrostomus new species Figure 63.

Depth $7\frac{2}{3}$; head 5, width $3\frac{1}{2}$. Snout $2\frac{2}{3}$ in head; eye $9\frac{4}{5}$, $3\frac{7}{8}$ in snout, $2\frac{3}{4}$ in interorbital, without free lids; mouth cleft long, deep, 2 in head, jaws even in front; interorbital $6\frac{1}{5}$, convex. Gill opening $5\frac{1}{2}$.

Scales 100 in lateral line to caudal base, runs high along side of body; scales smaller towards body edges above and below, 12 above lateral line and 30 below. Head naked. Caudal largely covered with small scales.

Small rudimentary dorsal posterior, length $3\frac{1}{2}$ in head; A. 146, greatest depth $4\frac{1}{4}$; caudal $4\frac{2}{3}$, small, rounded; pectoral rays II, 12, fin $2\frac{1}{2}$ in head. Vent opposite first third of postocular space.

Color in alcohol dark gray-brown generally, lower surface of head alone little paler. Beginning on front part of snout above median narrow pale brown band extends back nearly to rudimentary dorsal fin, though in posterior part of its course more narrowed, and widest on top of head. Veiled iris showing through pale buff. Broad buff band borders gill opening. Pectoral and anal light brown, in contrast with dark body color. Caudal pale terminally.

A.N.S.P., no. 70528. Villavicencio, Rio Meta basin, Colombia. 1931. Length 260 mm. Type.

Only the type obtained. Distinguished by its large mouth which extends beyond the eye and its length 2 in head, moderate pectoral only 2¼ in head. It approaches the photographic figures of Eigenmann identified as *Sternarchus rostratus,* though the snout is more attenuated.

(μακρὸς long + στόμα mouth.)

CYPRINODONTIDAE

Rivulus elegans Steindachner

Rivulus elegans Steindachner, Denks. Akad. Wiss. Wien, vol. 42, pt. 1, 1880, p. 85, pl. 6, fig. 6 (type locality, Rio Cauca, Colombia).—Henn, Ann. Carnegie Mus., vol. 10, nos. 1-2, art. 9, Jan. 31, 1916, p. 108 (Rio Condoto; Rio Truando, Colombia). —Eigenmann, Mem. Carnegie Mus., vol. 9, no. 1, Oct. 1922, p. 183, pl. 27, fig. 4 (copied Steindachner).

Thirteen, 34 to 56 mm., Villavicencio, 1931. They vary considerably in color, the blackish horizontal lines 3 to 6.

CICHLIDAE

Aequidens vittatus (Heckel)

Acara vittata Heckel, Ann. Wiener Mus., vol. 2, 1840, p. 346 (type locality, Matto Grosso).
Aequidens vittatus Eigenmann, Mem. Carnegie Mus., vol. 5, June 1912, p. 489 (British Guiana).

One, 62 mm., Florencia. Depth 2½; head 2⅗. Cheek with 3 rows of scales. D. XIV, 9; A. III, 7. Seven dark transverse bands on body, with black postocular band crossing 5 of them along below upper section of lateral line. Dark band across posterior part of interorbital. Narrow blackish vertical band, one scale wide, from lower eye edge down to lower preopercle edge. Small black spot at caudal base close above middle. Soft dorsal and anal with dark spots.

One, 63 mm., Cucuta near the Venezuelan frontier, basin of Lake Maracaibo, 1932. Depth 2⅖; head 2⅗. Cheek with 3 rows of scales. D. XIV, 10; A. III, 8. Eight dark brown transverse bands on body, first on tail divided so that 6 inclusive of basal caudal one. Black blotch below lateral line on third band and small black spot at caudal base above lateral line. Black band from eye through black lateral blotch to first transverse band on tail.

Aequidens mariae Eigenmann

Aequidens mariae Eigenmann, Mem. Carnegie Mus., vol. 9, no. 1, Oct. 1922, p. 240, pl. 30, fig. 1 (type locality, Barrigon; Cumaral; Cano Caanicerio; Rio Negro; east of Bogotá; Quebrada Cramalote, Colombia).

One, 103 mm., Villavicencio, 1931; sixteen, 66 to 158 mm., five miles south of Villavicencio, 1931; one, 122 mm., Rio Guayuriba south of Villavicencio, 1931.

Cichlasoma kraussii (Steindachner)

One, 110 mm., Honda, 1931.

Cichlasoma spectabilis (Steindachner)

Acara (Petenia) spectabilis Steindachner, Sitzs. Akad. Wiss. Wien, vol. 71, pt. 1, 1875, p. 96, pl. 4 (type locality, Amazon River at Gurupa and Obidos, Brazil).

Cichlosoma spectabile Regan, Ann. Mag. Nat. Hist. London, ser. 7, vol. 16, 1905, p. 339 (compiled).

One, 203 mm., Florencia.

Depth $2\frac{1}{6}$; head $2\frac{2}{3}$. Snout $2\frac{1}{2}$ in head; eye $5\frac{1}{8}$, $2\frac{1}{3}$ in snout, $1\frac{1}{2}$ in interorbital; maxillary reaches $1\frac{3}{4}$ in head; interorbital $3\frac{3}{4}$. Cheek with 8 rows of scales. D. XV, 13; A. V, 9. Pectoral $1\frac{3}{4}$ in head; ventral $1\frac{1}{5}$. Body with 6 blackish transverse bands, first from occiput to eye and then down on cheek to behind maxillary, bands on body reach well down to under part of both trunk and tail. Membrane of soft dorsal and anal more or less marked with gray spots. Ventral gray-black terminally.

Geophagus steindachneri Eigenmann and Hildebrand

Four, 37 to 110 mm., Honda, 1931; smallest with more vivid transverse dark bands, fourth on back blackish and a dark postocular band back until below suprascapula.

Three, 80 to 112 mm., Muzo, Rio Magdalena; one, Rio Gualanday southeast of Ibaque, Tolima, 1931.

Apistogramma corumbae (Eigenmann and Ward)

Heterogramma corumbae Eigenmann and Ward, in Eigenmann, MacAtee and Ward, Ann. Carnegie Mus., vol. 4, no. 2, 1907, p. 146, pl. 45, fig. 3 (indistinct photograph) (type locality, Corumba; Puerto Max, Paraguay).

Apistogrammus corumbae Eigenmann, Mem. Carnegie Mus., vol. 9, no. 1, Oct. 1922, p. 240 (Barrigon, Colombia).

One, 34 mm., Villavicencio, 1931. Cheek with 3 rows of scales. D. XV, 6. A. III, 5. Scales 11 + 9 + 2.

One, 30 mm., five miles from Villavicencio, 1931.

Crenicichla geayi Pellegrin

Crenicichla geayi Pellegrin, Bull. Mus. Hist. Nat. Paris, 1903, p. 123 (type locality, Venezuela); Mém. Soc. Zool. France, vol. 16, 1903, p. 375, pl. 6, fig. 4 (type).—Regan, Proc. Zool. Soc. London, 1905, p. 161 ("near Bogotà").—Eigenmann, Mem. Carnegie Mus., vol. 9, no. 1, Oct. 1922, p. 240 (Villavicencio, Cumaral, Barrigon, Colombia).

Four, 95 to 138 mm., Villavicencio, 1931; six, 105 to 178 mm., five miles from Villavicencio, 1931.

Color in alcohol brown, paler and immaculate on under surfaces. A blackish band, sometimes beginning on front side of mandible extends to eye, then back to opercular angle; all along middle of side it is reflected on 7 or 8 transverse dark bands, all inclined down and back, often appearing as more or less double to produce an H-like dark to blackish figure slanted back; on tail posteriorly these markings above and close along lower posterior section of lateral line; first spot on body above pectoral axil; all dark bands may also be more or less reflected along dorsal bases. At caudal base

a small black spot just above middle size of pupil. In some specimens the slanted appearance of the bands appears to have faded out leaving only a series of rounded dark blotches, the first 5 of which are all below upper section of the lateral line and the posterior ones above its lower section. Often a distinct black ocellus forms in the posterior opercular angle and at caudal base. Dorsals largely gray-brown and a black ocellus may spread over ninth or tenth to the eleventh to thirteenth spines and membranes; without an ocellus present upper half of spinous dorsal may be blackish brown with ends of incised membranes and spines whitish. Soft dorsal gray-brown, uniform (4 specimens with black ocellus) to marked with 6 or 7 longitudinal rows of spots (in 2 specimens without dorsal ocellus); anal in these in front and below submarginally dark gray, and posteriorly on soft fin 9 or 10 rows of small dark spots mostly on fin membranes; although lower dark margin present in all the other specimens, the posterior dark spots are little if at all evident. Caudal with 10 rows of dark spots on membranes, most vivid in 2 specimens with spotted soft dorsal and anal. Paired fins uniformly brown.

Crenicichla lugubris Heckel

Crenicichla lugubris Heckel, Ann. Wiener Mus., vol. 2, 1840, p. 422 (type locality, Rio Negro).—Regan, Proc. Zool. Soc. London, 1905, p. 165 (British Guiana, Rio Essequibo, Rio Capin).

Crenicichla brasiliensis var. *lugubris* Pellegrin, Bull. Soc. Zool. France, vol. 16, 1903, p. 383, fig. 42, no. 5 (Orinoco, British Guiana, Iça, Tocantins).

One, 45 mm., Florencia, 1932; one, 88 mm., Villavicencio, 1931; one, 126 mm., five miles from Villavicencio, 1931. Last specimen agrees with Pellegrin's outline figure, showing in addition the pale dorsals bordered above with dark gray and black along upper edge of soft dorsal. Lower anal edge dark gray. Upper and lower posterior marginal corners of caudal gray black, contrasted with a submarginal whitish bar along that of upper; fin with 3 or 4 transverse dark gray suffusions.

REVIEW AND SUMMARY OF TERTIARY AND QUATERNARY NON-MARINE MOLLUSKS OF CHINA

BY TENG-CHIEN YEN

INTRODUCTION

During the age of mammals, it is well known that mollusks have played a very important, if not equally prominent, part in the animal kingdom. This is indicated not only by the great number of fossil molluscan species, but also by the abundance of individuals. Because of the durable nature of their shells, they have been more generally preserved, in strata of every age, than the remains of any other organisms. Moreover, the fossil species furnish simple and convenient morphological characters as well as developmental records of the animals in the form of shells, which are readily available for investigation. Of course, these remains are sometimes subject to deformation and distortion during the process of fossilization, but they are generally well preserved and rarely need restoration.

Considerably more than a century ago, Lyell first introduced the percentage method for the determination of the age of the Tertiary strata on the basis of the molluscan fauna. Since then, this has been considered a convenient and rather reliable method of obtaining a preliminary estimate of the age of new material under consideration, provided that knowledge of the recent fauna is sufficiently complete.

On the other hand, it may also be noted that a comprehensive comparative review of the extinct molluscan fauna in different strata often serves as a good basis for ascertaining the age of new material, hence also the age of the corresponding strata. Odhner in 1921 has presented an example by his determination of the Eocene deposit of the Yuanchu formation. His conclusion was based almost entirely on the shell remains collected from that deposit by Andersson, and his conclusion was confirmed some fifteen years later by the mammalian remains of the same deposit as worked out by Young.

Furthermore, mollusks may be employed possibly to establish an evolutionary series of the animals, which are of stratigraphical importance. The contribution of Neumayr and Paul on the succession of species of *Viviparus* found from " Levantine " formations is a good example of this phase of study. The species show a branching series of sculptured types with a certain general trend and they also show gradational occurrence from a perfectly smooth form (*V. neumayri* Brusina) in the lowermost strata, to the

strongly carinated types (*V. hoernesi* Neumayr) in the upper beds. A similar series has been established for the Unios by the findings of *U. atavus* Partsch in the lower and *U. clivosus* Brusina in the upper formations of west Slavonian lake beds.

The fossil mollusks are usually also good indicators of the ecological conditions then existing. From the great number of *Bulimus* (=*Bithynia*) species found from Chutsing formation in Yunnan province may be inferred the presence of abundant aquatic plants, and the findings of larger forms of *Viviparus* often indicate considerable size of the water-body. Whenever these species were discovered in association with the forms of *Pseudophysa,* which is a genus intermediate between *Isidora* and *Camptoceras* and related closely with *Culmenalla,* it suggests further that the material might come from a shore deposit of a rather large and deep lake of the past.

Similarly, the species of terrestrial mollusks give equally good suggestions regarding the climate, vegetation, soil, etc., of the environment then existing. The species of land operculates, *Cyclophorus* for instance, live preferably in the subtropical zone, feeding upon decaying vegetable matter; the species of *Bradybaena* are also vegetarians but live more commonly in a temperate and humid climate; the forms of *Cathaica* can stand a far more arid region; and members of *Clausilia* live in humid and warmer regions. Thus a knowledge of the ecological conditions as well as the geographical distributions of the recent mollusks will enable us to reconstruct the environmental factors prevailing in earlier times, and will undoubtedly enrich our knowledge of historical geology.

In presenting a summary of the molluscan forms existing in Tertiary and Quaternary formations in China, the author believes that such a work may be useful as a basis for further investigations. Besides, in previous works, as will be seen, quite a number of records are either doubtful or erroneous; these, if not properly checked, may be misleading. The comparatively small number of species so far recorded, in contrast with the vastness of the field, shows how imperfect is our knowledge of Tertiary and Quaternary molluscan faunas in China, a subject which needs much more attention because of its importance in geological sciences.

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Review of the Literature

Of various Tertiary and Quaternary strata in China, the loess was probably the first deposit known to modern geologists, and from it we have our earliest records of molluscan remains described by von Martens 1879, which were based on the material obtained by von Richthofen from Honan province. The types of von Martens' species are now preserved in the Zoological Museum in Berlin. Subsequently, in 1883 and 1884, Hilber reported on the collection of land mollusks made by Loczy, a geologist who participated in the Eastern Asiatic Expedition under the leadership of Grafen Bèla Szechenyi. This paper was reprinted in the scientific results of that expedition, which were not published until 1898. Hilber described and recorded some 14 forms from the loessic deposits found in Shensi and Kansu provinces, together with a number of other living forms from various parts of interior China. He differentiated the redeposited loess from the original formation as what he called " Jungerer Thalloess " and he made the comparison in a table containing loess, redeposited loess, and living forms, representing the material available to him.

In the beginning of the present century, Sturany's " Obrutschew's Molluskenausbeute aus Hochasien " appeared, in which this Austrian naturalist recorded a number of species from what he called " rothe und grüne Thone " which was considered as of Post-Tertiary or Tertiary age. Almost at the same time, Andraea made an important contribution towards Chinese malacology, which was included in the third volume of Futterer's " Durch Asien " published in 1903, and in which he recorded an extensive collection of Chinese mollusks made by Futterer, including quite a number of loessic species from Shensi and Kansu provinces. The first four of the six sections of this memoir first appeared as " Mittheilungen " of the Roemer Museum in 1900, in which he primarily dealt with the land forms and proposed dividing the genus *Cathaica* Moellendorff into subgenera: *Eucathaica, Pliocathaica, Xerocathaica* and *Campylocathaica.* The detailed records of species are fully treated in the last two, namely fifth and sixth, sections.

Molluscan species from other than loess formations were recorded by Max Schlosser in 1906. His material was mainly collected by Loczy in Kansu and by Cholnoky in " Manchuria ", and included a few by others from Karkarà, east of Issikul Lake (Russian Turkestan). He assigned these

lots to Pliocene age, but he was so cautious as to have identified most of his forms only to genera, such as *Limnaeus, Planorbis, Helix, Pupa,* etc., although he made careful comparison of his species or forms with those existing in Pliocene, Pleistocene, and recent formations of Europe.

Since the discovery of the fossil remains of *Sinanthropus,* the Cenozoic formations of China have become increasingly interesting to palaeontologists. The fossil findings of Tertiary and Quaternary strata from various localities in China have been reported from time to time, including studies of the molluscan fauna as worked out, in the last two decades, by Odhner, Ping, Hsu, King, as well as the present writer. On account of insufficient library facilities and lack of proper material for comparison, our workers in China had to face for quite a while conditions which affected considerably the accuracy of their results, particularly with regard to the identification of species. A few changes and rectifications are proposed in the following pages.

SUMMARY OF THE FOSSIL CONTENTS

I. *The Eocene Formation*

The only known Eocene formation of China from which molluscan remains have been described is the one found near Yuanchu Hsien of South Shansi province. It lies beneath the loess and gravel and consists of beds of red-brown and multicoloured clay together with a marly limestone bed. The formation was described by Andersson in 1916 and observed in further detail by him in 1921. The molluscan forms were studied by Odhner who reported the occurrence of the following species from the deposit:

Planorbina pseudoammonius (Schlotheim)
Planorbina pseudoammonius leymeriei (Deshayes)
Planorbina sparnacensis (Deshayes)
Hippeutis chertieri (Deshayes)
Planorbis sinensis Odhner
Aplexa cf. *pulchella* (Orbigny) (=*Physa* cf. *lamberti* Deshayes)
Stalioa gregaria (Bronn) (=*Euchilus deschiensianum* Deshayes)
Eupera sinensis Odhner

The main argument advanced by Odhner was that some of the species found in the deposit agree well with Eocene forms of Europe, for instance *Planorbina pseudoammonius* (Schlotheim), which is one of the leading index fossils of the limnic deposits of the upper Eocene Lutetian. His conclusion was confirmed by Young in 1937 that most of the mammalian remains found in this formation are also typically upper Eocene fossils with but a few also found in the Oligocene.

II. *The Miocene Formation*

The only Miocene bed from which molluscan remains have been reported is the deposit from Tung-gur of Sie-yuan province (Inner Mongolia). The formation was discovered by Spock in 1928 and described in 1929 as of

lower Pliocene age. Subsequently, it was further investigated, and on the basis of mammalian findings (species of *Macrotherium*) it was considered to be upper Miocene. The molluscan forms were reported as containing the following species of Unionids:

Lamprotula mongolica Leroy
Lamprotula elegans Leroy
Lamprotula tungurensis (Leroy) = *Sulcatula tungurensis* Leroy
Lamprotula sp. = *Sulcatula* sp.
Cuneopsis spocki Leroy
Cuneopsis teilhardi Leroy
Cuneopsis sp.

However, this formation contains also a few forms of freshwater gastropods and the specimens were identified by Ping as *Planorbis chihliensis* Ping (= *Gyraulus sibericus* Dunker) and *Limnaeus teilhardi* Ping (= *Radix plicatulus* Benson), which he described from San Men Series of Shansi province and which belong to the Lower Pleistocene. Since the original specimens of gastropods from Tung-gur are not at hand and no illustrations of these forms could be traced, I am not able to confirm Ping's determinations. Judging by the wide separation of the upper Miocene and lower Pleistocene, the identity of these forms is highly questionable.

III. *The Pliocene Formations*

1. The Yungning Formation

(Lower Pliocene)

There are three collections of freshwater mollusks reported from this formation of Kwangsi province. The first one was made by V. K. Ting near Nanning (Yungning), which was studied by Odhner in 1930 and consists of the following species:

Hyriopsis arcidens Odhner
Psilunio ellipticus (Odhner)
Psilunio ventricosus (Odhner)
Psilunio spinifer (Odhner)
Psilunio tuberosus Odhner
"*Tulotoma*" *gigas* Odhner
Gangetia rissoides (Odhner)
Gangetia rissoides minor (Odhner)
Gangetia brevis (Odhner)
Stenothyra fasciolata Odhner
Stenothyra supracarinata Odhner
"*Stenothyra*" *gibbula* Odhner
"*Stenothyra*" *percarinata* Odhner
"*Stenothyra*" *costellata* Odhner
"*Stenothyra*" *marginata* Odhner
"*Stenothyra*" *scala* Odhner
Pyrgula sinensis Odhner
Oncomelania sp.
Valvata sp.

Another one was made by C. Li at Napo, about 45 kilometers southeast of Paise and 250 kilometers northeast of Nanning (Yungning). The species, which were described by S. C. Hsu in 1935, are as follows:

Kwangsispira accelerata Hsu
Kwangsispira grabaui Hsu
Viviparus kwangsiensis (Hsu) = *Tulotoma Kwangsiensis* Hsu
Viviparus lii (Hsu) = *Tulotoma lii* Hsu
Viviparus lii parvius (Hsu) = *Tulotoma lii* var. *parva* Hsu
Viviparus paucilineatus (Hsu) = *Paracampeloma paucilineata* Hsu

Viviparus chui (Hsu) = *Paracampeloma chui* Hsu
Viviparus obsoleta Hsu
Viviparus ovatus Hsu
Semisulcospira napoensis (Hsu) = *Melania aubriyana* var. *napoensis* Hsu
"*Melania*" *hsuiana* Yen = *Melania turrita* Hsu, non Klein 1846
Stenothyra parviglobosa (Hsu) = *Nematura parviglobosa* Hsu

Still another small collection was made by L. C. Li near Nanning (Yungning), which comprises only three forms but with a considerable number of examples for the two determinable species:

Sinomelania leei Yen
Viviparus wongi Yen
Pila sp.

It is interesting to note that the above collections are considered to be the lake deposits from three different localities which are in close proximity to each other. Odhner correlated his material with that of "the Rumanian Pliocene beds which contain Unionids and *Tulotoma* and belong to the Levantine stage", and his conclusion was followed by C. S. Hsu for estimating the age of his material from Napo. If so, they are all of lower Pliocene, and they are not only from adjacent localities but are of the same age.

By careful comparison of the contents, it is noticeable that the elements of each collection are found to have very little in common; however, the minor connections are not entirely absent. "*Melania*" *hsuiana* (nom. nov.) appears to be another thalassoid form in addition to the species I have already described, and moreover, the species of typical *Stenothyra* are contained both in the collections of Nanning and Napo. They all contain large species of Unionidae, although those from Napo are not yet described. The small common elements may be explained by the fact that these forms may represent various distinct facies in the area, and further details may be ascertained when more comprehensive collections from this formation are available.

It has been pointed out elsewhere that the "thalassoid" elements found in the Yungning formation may be of high interest suggesting similarity to the living fauna existing in lakes of central Africa. The common genera in Lake Tanganyika are *Lymnaea, Planorbis, Pila, Viviparus,* together with Unionids and thalassoid gastropods, and those in Lake Moero are *Lymnaea, Planorbis,* and *Rectiviviparus*. These genera are mostly represented in the collections of Yungning formations. It is true that the presence of a number of typical *Stenothyra* seems to be a puzzling fact as these species usually live in an estuary, requiring constant freshing of brackish water, but in the recent molluscan fauna of China, typical species of *Stenothyra* have been not infrequently recorded from fresh-water habitats. These species from the extinct lake deposits may infer a wider range of the habitat of this genus.

2. The "Red Clay" of Shueh-hwa-shan (Lower Pliocene)

From Shueh-hwa-shan of Chingshing in Hopei province, C. C. Wang collected a few forms of terrestrial snails which were described by Ping in 1929, and contains the following species:

Cathaica fasciola (Draparnaud) = *Helix pyrrhozona* Philippi
Vallonia hipparionum (Ping) = *Helix hipparionum* Ping
Pupilla grabaui (Ping) = *Pupa grabaui* Ping
Pupilla hopeiensis (Ping) = *Pupa hopeiensis* Ping
Microstele pingi Pilsbry = *Pupa subconica* Ping, non Sandberger 1858
Opeas chingshingensis Ping

So far as the remains of mollusks are concerned, it consists of 95 per cent extinct forms. They are practically all congeneric with those found in the Pleistocene and Recent times, and yet they are quite characteristically different in specific features. The sinistral form of *Pupilla* and species of *Microstele*, while no longer existing in China, still live farther south in India.

3. The Fresh-water Bed of Kauteh (Quetä) (Upper Pliocene)

During the Eastern Asiatic Expedition of 1877 to 1880, Loczy made also a small collection of fresh-water mollusks near Kauteh (Quetä), in the northwestern part of Kansu province. The material was studied by Max Schlosser in 1906, who recorded the following forms:

Limnaeus aff. *ovatus* Mueller
Limnaeus sp.
Limnaeus aff. *peregra* Mueller
Planorbis (*Gyrorbis?*) sp.
Planorbis sp.
Valvata piscinalis Mueller
Bythinia sp.
Helix (*Vallonia?*) sp.
Pupa?

4. The Chutsing Formation (Upper Pliocene)

From Chutsing of Yunnan province, Y. L. Wang made an interesting collection of fresh-water mollusks which I described in 1935 as containing the following species:

Viviparus tingi Yen
Viviparus wangi Yen
Viviparus chutsingensis Yen
Viviparus tulotomoides Yen
Pseudophysa grabaui (Yen) = *Aplexa grabaui* Yen
Pseudophysa g. brevispira (Yen) = *Aplexa grabaui brevispira* Yen
Pseudophysa cylindrica (Yen) = *Aplexa cylindrica* Yen
Bulimus pingi Yen
Bulimus kingi Yen

In 1918, Mansuy described and recorded the following forms from Chi-li-pau-tang of Mongtze in south Yunnan, which seem to be of the same age:

Margarya melanoides mansuyi Dautzenberg et Fischer
Viviparus margaryaeformis (Mansuy)

Judging by these molluscan remains, it does not seem to be much older than the Upper Pliocene. The abundance of highly specialized forms of

viviparids in association with species of *Bulimus* and *Pseudophysa* may be correlated with those advanced types found in Slavonian beds of Europe, generally considered to be Upper Pliocene. The species of *Bulimus* resemble closely those found in the recent fauna. This seems to be in accordance with the conclusion of Saurin as what he assigns to " Piocène supèrieur et au Quaternaire ancien " for these lacustrine beds of Yunnan. It is true that some of the viviparids are found also in the older formations such as Yunning Formation of Kwangsi, but their bionomic contents are not very similar, nor do morphological characters of those species show close relationship with that of the forms in the same genus still living.

IV. *The Pleistocene Formations*

1. The San Men Series

This formation was first discovered by the late V. K. Ting at the San Men Rapids on the border of Shansi and Honan provinces. In the type locality, the formation lies directly underneath the loess deposit. It consists of gravels and sand in which large unionids are found in abundance. Subsequently, J. G. Andersson discovered a second locality of the same series in Ho-ti-tsun of Yuanchu Hsien in south Shansi. Later this series was also known in Huailai and Tangshan of Hopei province, from which some of the fresh-water shells were also reported.

The molluscan remains of the type locality were preliminarily determined by Dall, but his result was not published but given in form of a private communication which was quoted by Andersson in 1921. However, from Yuanchu Hsien, Andersson made a very extensive collection of shells which was studied by Odhner in 1925 and his report contains the following species:

Solenaia carinata (Heude)
Anodonta woodiana Lea
Cristaria herculea (Middendorff)
Hyriopsis descendens Odhner
Lepidodesma ponderosa Odhner
Nodularia douglasiae (Gray)
Cuneopsis maximus Odhner
Lamprotula antiqua Odhner
Lamprotula antiqua undulata Odhner
Corbicula fluminea (Mueller)
Corbicula largillierti (Philippi)
Radix clessini (Neumayr)
Metodontia houaiensis (Crosse)
Cathaica plectropis (Martens)
Platypetasus anderssoni Odhner

In addition to the above list, S. G. King in 1926 added an elongated form of *Lamprotula antiqua* Odhner, as *elongata* King, also from Yuan-chu Hsien; and in the same paper he reported *Cuneopsis barbouri* King from Huailai of Hopei province. Both forms were inadequately described without illustrations.

In 1931, Ping reported a few incidental collections from different localities from north China, probably of San Men Series. These collections contain the following species:

1. Tangshan, Hopei

Gyraulus sibericus (Dunker) = *Planorbis chihliensis* Ping
Opeas filare (Heude) = *Opeas fragilis* Ping

2. Tatung and Fenho Beds, W. Shansi

Gyraulus sibericus (Dunker) = *Planorbis chihliensis* Ping
Radix lagotis (Schrank) = *Limnaeus grabaui* Ping
Radix plicatulus (Benson) = *Limnaeus teilhardi* Ping
Radix shansiensis (Ping) = *Limnaeus shansiensis* Ping
Parafossarulus striatulus (Benson) = *Fossarulus greenmani* Ping

3. Hutoho, Shansi

Cochlicopa lubrica (Müller) = *Opeas lata* Ping

4. Red Clay of Fenho, Shansi

Metodontia houaiensis (Crosse)
Metodontia tetrodon (Moellendorff)
Cathaica fasciola (Draparnaud) = *Eulota (Cathaica) pyrrhozona* (Philippi)
Radix plicatulus (Benson) = *Succinea elegans* Ping

It should be mentioned that under the species *Succinea elegans* Ping, the original author seemed to have included some heterogeneous elements. According to his description and the illustration on his plate II, figure 13a, b, it agrees well with a young form of *Radix plicatulus* (Benson); but his figure 13c, d, appear to be *Succinea chinensis erythozona* Ancey. The species of *Lymnaea* usually have more exserted apical whorls, an umbilicus, more or less reflected inner lip, and somewhat twisted columella.

2. The Chou-kou-tien Deposit

This deposit is well known by its rich contents of fossil remains among which the skulls of *Sinanthropus pekinensis* were discovered. The site was found in the summer of 1921 and since then it has been systematically excavated. Judging by the mammalian contents, it is generally considered to be Lower Pleistocene. The molluscan remains are comparatively little known except the following list of species reported by Ping in 1929:

Galba pervia (Martens) = *Succinea tenius* Ping
Gyraulus sibericus (Dunker) = *Planorbis chihliensis* Ping
Succinea altaica Martens = *Succinea debilis* Ping
Truncatellina micra (Ping) = *Pupa micra* Ping
Opeas filare (Heude) = *Opeas fragilis* Ping
Cochlicopa sinense (Heude) = *Opeas lata* Ping
Cochlicopa davidis (Ancey) = *Opeas lata* Ping
Zonitoides choukoutiensis (Ping) = *Helix choukoutiensis* Ping
Cathaica fasciola (Draparnaud) = *Helix pyrrhozona* Philippi
Cathaica pulveratrix (Martens) = *Helix schensiensis* Hilber

In the above list, it may be well to notice that according to the original determination by Ping, only two out of nine species are known in previous records, that is about 22 per cent, while the present revision consists of seven out of nine species or about 78 per cent represented by the recorded forms.

Practically all the known forms are still living throughout north China. The later determination seems to be more consistent with its lower Pleistocene age and in accordance with the result based on the vertebrate remains.

3. The Loess Deposit

The loess or " Huangtu " is a kind of brown or brownish yellow homogeneous loam, so friable that it can be easily rubbed to an impalpable powder with the fingers, and yet at same time so firm that in places, where through erosion by running water large masses have been broken off, the main deposit retains a vertical wall, sometimes a hundred feet in height. It is frequently perforated by long and minute vertical root-like tubes. Its thick deposit always has a strong tendency to cleave in vertical planes but lacks stratification. It contains commonly fossil land shells with but few of fluviatile origin. Mammalian bones of herbivorous and carnivorous animals are imbedded in the deposit with which eggs of *Struthiolithus* are not infrequently found.

The loess formation was first described from the valley of the Rhine by Lyell in 1834, and subsequently, it was recognized in southeastern Europe as well as south Russia and Turkestan, North America along the Mississippi river and very extensively covering north China along the Hwangho valley. Comparative studies of the formations deposited in different parts of the world have been made successively by geologists during the last half century and their results seem to have revealed the fact that they are precisely similar in composition, distribution and contents of fossils, although they may not be of the same origin.

The loess of China was well described by von Richthofen in 1870 in his " Letter on the Province of Honan and Shansi " of 1872. The subject was fully treated and discussed again in his voluminous work on " China "; the first volume of that work was published in 1877. However, it may be well to notice that before von Richthofen, Raphael Pumpelly in 1866 had directed attention to this widely distributed deposit observed during his journey in China from 1863-1864, and which he called " Terrace Deposit." About the same time, Pére David also noticed this vast formation while he travelled in China, but it was Richthofen who pointed out definitely for the first time its correlation with the loess of the Rhine valley. His profound knowledge and comprehensive discussion from many years of study on these deposits has made him the leading authority on problems of the loess.

In the last half century, the loess of China has been continuously studied from different points of view by field geologists and naturalists. Among them, we may mention Loczy, Kingsmill, Wright, Willis, and more recently Andersson, as well as a few palaeontologists who worked on the organic remains contained in these formations. Similar to the fact that the opinions

on the loess of other parts of the world have been so widely varied, this extensive deposit in China has also aroused controversial problems among geologists, especially respecting its origin and mode of deposition.

According to Pumpelly in 1866, the "Terrace Deposit" was formed by a chain of isolated freshwater lakes and the loam was brought into the lakes by one or more large rivers which must have drained an area of great extent. In other words, the origin of these deposits is from fresh-water sources. On the contrary, von Richthofen in 1870 concluded that the loess of China was formed on dry land by an eolian deposit of material derived from the desert and steppe area in central Asia. On the other hand, Kingsmill, almost at the same time (1871), arrived at an entirely different conclusion that the loess of China was of marine origin. His argument was mainly based upon some of his observation along the Yangtze valley. He tried to present the evidence that a depression had existed in China during the early Tertiary period, so that "the bold escarpments of the hills on either side of the Yangtze" were taken as the ancient coast-line. However, he did not prove that what he called the shore deposit was marine, nor was it the same age as the loess which he described. Still another theory was advanced by Geikie, who suggested, on the basis of his scattered observations on the great part of north China, that there once existed ice-masses that left their load and traces all over north China, so that he was led to believe that the loess of China was a deposit of fluvio-glacial origin.

Since the foregoing opinions seem in one way or another to be hardly satisfactory, the problem has been left at an unsettled stage. However, the recent research work seems to show with increasing clearness that any generalization as to the origin of loess as a whole by any single means or on the basis of observations in any single locality, is no longer tenable. The above explanations, with the exception of that of marine origin which is extremely unlikely as to the loess of China, seem either alone or in combination to account for the loessic deposits in different localities. Wright in 1901 concluded, after making very extensive field observations in China as well as in central Asia, that the loess of China was formed by means of both wind and water; and his theory was further supported by Willis in 1907, who also maintained that the disintegrated material was transported and sorted by wind during the dry season and on wide plains and by water during the rainy seasons and in river valleys. But, nevertheless, those formed on the high mountains may be still better explained by ice-action, since glacial evidences in China have recently been further discovered by J. S. Lee in different parts of the country.

The climatic conditions of the loess period in China is also not quite known, nor is the age of the formation well determined. The best clues to the solution of these problems are perhaps the palaeontological findings,

in which the molluscan remains are important elements by reason of their abundance throughout this deposit.

In mentioning the molluscan remains of the loess formations, one immediately thinks of its representative forms as " Helix " or " Helicidae ". In most of the early literature, and even in some of the recent works, this group of terrestrial snails has been taken for the species of *Bradybaena, Cathaica, Metodontia,* etc.; in other words, it may represent the land shells found in the formations. On the other hand, the early palaeontologists or palaeoconchologists, such as von Martens, Hilber, Sturany and Andraea, made very valuable contributions on the molluscan fauna of the loess formations and their reports were based on the collections made by von Richthofen, Loczy, Obrutschew, and Futterer respectively during their journeys in China. These early geologists have undoubtedly given useful information and valuable data of geological importance, but they all seem to have exaggerated the thickness of the loess formation in China to an enormous extent. According to Andersson, the genuine loess in north China is at most only 50 to 60 meters in thickness, which is about the same as that found in other parts of the world. The difference in opinion as to the thickness of the loess in China is partly due, according to Andersson, to the fact that the early geologists included the older deposits of different epochs of the Tertiary, containing *Hipparion* for instance, which look so much like the loess formations at its top. This might have affected the classification of the fossils that have been collected. The previous records accordingly are worth examining. The species are in the summary given below:

I. Shansi Province:

1. Between Ju-tou-ho and San-yang-ho, by Sturany 1901

Cathaica richthofeni (Martens) *Cathaica pulveratrix* (Martens)
Cathaica orithyia (Martens)

2. From Chung-pu-ssa, by Sturany 1901

Metodontia huaiensis (Crosse) *Cochlicopa davidis* (Ancey)

II. Honan Province:

1. Near Honanfu (Keifung), by Martens 1879

Cathaica fasciola (Draparnaud) *Cathaica richthofeni* (Martens)
Cathaica orithyia (Martens) *Metodontia yantaiensis* (Crosse et Debaux)

III. Shensi Province:

1. Sian, Weiho valley, by Hilber 1883

Cathaica pulveratrix (Martens) *Euconulus* cf. *fulvus* (Mueller)
Metodontia huaiensis (Crosse)

2. Lan-tien Hsien, by Hilber 1883

Cathaica pulveratrix (Martens)

3. Tai-fu-tze, by Hilber 1883

   Cathaica richthofeni (Martens)

4. At left side of Tung-ho, by Sturany 1901

   Cathaica fasciola (Draparnaud)
   Succinea evoluta Martens
   Opeas schensiensis Sturany

5. Tsing-ling-shan, Sian, near Ping-liang-fu to Lung-ku-tschai, by Andraea 1903

   Macrochlamys amdoana Moellendorff
   Metodontia huaniensis (Crosse)
   Cathaica fasciola (Draparnaud)
   Cathaica pulveratrix (Martens)
   Cathaica richthofeni (Martens)
   Cathaica przewalskii (Martens)
   Pseudiberus futtereri Andraea

IV. Kansu Province:

1. Lan-chow-fu, by Hilber 1883

   Cathaica przewalskii (Martens)
   Cathaica richthofeni (Martens)
   Pupilla chinensis (Hilber)
   Cathaica orithyia (Martens) (by Sturany 1901)

2. Kung-chang-fu, by Hilber 1883

   Cathaica pulveratricula (Martens)
   Cathaica orithyia confucii (Hilber)
   Pupilla muscorum (Linné)
   Succinea oblonga Draparnaud

3. Ku-lang-hsien, by Hilber 1883

   Cathaica kreitneri (Hilber)

4. Hoi-ning-hsien, by Hilber 1883

   Pupilla richthofeni (Hilber)
   Pupilla aeoli (Hilber)

5. Near Liu-lu village, E. Kansu, by Sturnay 1901

   Cathaica pulveratrix (Martens)
   Cathaica pulveratricula (Martens)
   Metodontia houaiensis (Crosse)

6. Upper layer of loesshill, between Ta-ho and Yun-ning-ho, by Sturany 1901

   Bradybaena ravida redfieldi (Pfeiffer)
   Bradybaena similaris (Ferussac)
   Mirus euconymus (Sturany)
   Clausiliopsis szechenyi (Boettger)
   Cathaica fasciola (Draparnaud)

7. Lao-ho, E. Kansu, by Sturany 1901

   Cathaica pulveratrix (Martens)
   Metodontia houaiensis (Crosse)

8. Ta-ho valley, Ning-chow, by Sturany 1901

   Bradybaena stimpsoni (Pfeiffer)
   Cathaica przewalskii (Martens)

9. Pei-shiu-kiang valley, near Kje-chow, S. Kansu, by Sturany 1901

   Cathaica gansuica Moellendorff
   Buliminopsis subcylindrica Moellendorff
   Buliminopsis potanini Moellendorff

10. Lower Tsai-tsa-ho valley, East of Nanshan, by Sturany 1901

    Cathaica przewalskii (Martens)

11. Between Kan-chow and Chin-chao-yi, W. Kansu, by Andraea 1903

Cathaica kreitneri (Hilber)
Cathaica orithyia confucii (Hilber)
Cathaica ohlmeri Andraea 1903
Cathaica przawalskii (Martens)
Cathaica pulveratricula (Martens)
Vallonia ladacensis tibetana Moellendorff
Vallonia tenera Reinhardt
Cochlicopa lubrica (Mueller)
Succinea altaica Martens
Pupilla muscorum (Linné)
Pupilla cupa turcmenica (Boettger)

12. Near Chin-chao-yi, by Andraea 1903

Euconulus fulvus (Mueller)
Cathaica orithyia confucii (Hilber)
Cathaica richthofeni (Martens)
Cathaica kreitneri (Hilber)
Cathaica ohlmeri Andraea 1903
Cathaica pulveratricula (Martens)
Vallonia ladacensis tibetana Moellendorff
Vallonia declivis altilis Sterki
Vallonia tenera Reinhardt
Succinea altaica Martens
Pupilla muscorum (Linné)
Pupilla cupa turcmenica (Boettger)
Columella columella (Benz)

In the above summary we can easily note how little information on the molluscan fauna of the loessic formation we have had recorded as compared with the vast area it covers in north China. However, it evidently shows that the elements are generally Palaearctic in character, and essentially similar to those now living in north China with but minor changes. The genus *Cathaica* seems to have been a dominant group then as it is now, and yet it was less prolific in species; *Bradybaena* yielded also fewer forms than it does in the present time. Between these two genera, *Cathaica* had more species than *Bradybaena.* Of Enidae there are only two species recorded, while it has no less than a score of species now existing in north China, and there are still more forms of that family found along the Yangtze valley. The smaller number of species and of individuals may be of course due to insufficient work of exploitation, however, it may also have been due to the drier and colder climate. This seems to be more evident when we compare the recent molluscan fauna in China; more species of *Cathaica* exist in north China than in the south, while the climate is drier and colder in the north. On the other hand, *Bradybaena* yields more species in south China than in the north, as they live preferably in humid forest land with temperate climate.

Furthermore, the above list also shows that almost all the species therein contained are represented in the living fauna, with but a few exceptions where the specific identifications need further consideration. These species are either living in the same region or its neighbourhood, and some of them are widely distributed over other parts of north China. Moreover, the specimens from the loessic deposits are generally preserved in perfect state, and not uncommonly the shells look rather fresh and retain color bands. From the facts, it may be inferred that the formation is of a late stage in the Pleistocene, which is quite consistent also with the arid condition which prevailed at that time.

4. The Para-loess Formation

Still much less known than the loess formations of north China, we have other scattered deposits found at different localities in the south of the Yangtze valley as well as in the western part of the country. It has been variously named as Siashu Loam, Chentuh Clay, etc. The deposit is brownish yellow to grayish yellow in color, rather sticky and plastic, variably from 30 or more meters in thickness, but non-stratified. It is apparently different from the true loess, but judging by its fossil remains known to this time, it seems to be of a rather later age, probably equivalent to that of the loess in north China.

There are so far two localities from which molluscan remains have been recorded, one collection from Pa-hsien in eastern Szechwan and another from Siashu in Kiangsu. The former contains the following species of land shells:

Xestina chrysoraphe krejcii Haas
Macrochlamys sp.
Aegista accrescens Heude
Cathaica constantiae vestita Pilsbry
Coccoglypta pinchoniana (Heude)
Vallonia pulchella (Heude)
Subzebrinus fuchsiana (Heude)
Cyclophorus punctatus (Grateloup)
Cyclophorus exaltatus youngi (Yen)

The Siashu collection contains more land forms with but a few freshwater species, which were reported by S. C. Hsu as containing the following species:

Traumatophora trisculpta (Martens)
Traumatophora fraterminor (Gredler) = *Traumatophora trisculpta* (Martens)
Ganesella squamosella (Heude)—include *G. s.* mut. *depressa* Hsu
Buliminopsis buliminoides (Heude)
Bradybaena ravida redfieldi (Pfeiffer) = *Eulota phragmitum* (Heude) Hsu
Bradybaena similaris (Ferussac)—include *Eulota s.* mut. *lungtanensis* Hsu
Aegista chinensis (Philippi)
Aegista pseudochinensis (Moellendorff) = *Eulota* (*A.*) *chinensis* (Phil.) Hsu
Aegista sp.—*Eulota* (*A.*) cf. *vermis* (Reeve)
Hemiphaedusa heudeana (Moellendorff) = *Clausilia obliterata* Hsu
Mirus cantori (Philippi)—*Buliminus cantori* Philippi
Mirus funiculoides (Hsu)
Opeas filare (Heude)—*Opeas siashuensis* Hsu
Diplommatina pupinella Heude
Cyclophorus martensianus Moellendorff = *Cyclophorus pallens* Heude
Viviparus quadratus (Benson) = *Bithinia viviparoides* Hsu
Parafossarulus striatulus (Benson) = *Fossarulus exiguus* Hsu

Judging by these incidental collections of mollusks, we can easily see that almost 95 per cent of the species is represented in the living fauna, besides they are the same elements as those existing in the similar districts at the present time. Such a fauna lives more favourably in humid and warm climate and the presence of both species of *Traumatophora* may indicate that the land might have been covered with richer forest.

The two fresh-water species contained in the Siashu formation are extremely common forms in lower Yangtze valley. *Viviparus quadratus* is

represented by a young form, and the single specimen was collected by itself from a separate locality and its occurrence in the Siashu formation is rather doubtful. *Parafossarulus striatulus* is also represented by a single and imperfect example from a locality where most of the land forms were collected. It was described as "strongly fossilized" and only more specimens will establish its record more definitely.

5. " Yellow Deposit "

This cave deposit, as reported by Odhner from Maping (Liu-chow) of Kwangsi province. It consists of the following species of mollusks:

Nodularia triformis (Heude)
Lamprotula cornuumlunae (Heude)
Viviparus quadratus (Benson)
Brotia swinhoei (H. Adams)
Bradybaena kiangsiensis (Martens)

All the above species are represented in the living fauna and are now mainly distributed along the Yangtze valley. The cave deposit has been considered by Teilhard and others as old as lower or middle Pleistocene, but that can not be confirmed by the few molluscan data as mentioned above. Since it consists of entirely recent elements, the cave fauna seems to be not older than upper Pleistocene, probably parallel to the age of loess formation in the north.

6. The Kweilin Cave Deposit

This deposit appears to be even more recent than the preceding one, probably of post Pleistocene or recent age. It is by far later than Chou-kou-tien Cave deposit in the north. A few forms of Viviparids have been reported by Hsu:

Viviparus chinensis (Gray) = *Vivipara* cf. *lecythoides* (Benson) Hsu
Viviparus quadratus limnophilus (Mabille) = *Vivipara dispiralis* (Heude) Hsu
Viviparus occidentalis (Annandale) = *Vivipara leei* Hsu + *Vivipara leei* var. *distincta* + *Vivipara leei* var. *convexa* Hsu + *Vivipara kweilinensis* Hsu

These species are at present commonly found in that part of the country as well as in the neighboring province, Yunnan. These shells, according to Hsu, were found to be in association with some species of *Corbicula* which were not described. Nothing can be concluded from these few forms of Viviparidae more than that they are consistent with a very recent age. It seems to be not an illogical suggestion that these shells were left by the " shell-eating " dwellers, however, the few specimens at Hsu's disposal are said to be " slightly eroded, while the majority are not at all worn," if so, it seems to be a puzzling fact. The specimens are expected to be decollated as badly as that illustrated by Hsu on his plate III, figure 4 and 5.

Systematic Account

GASTROPODA

Pectinibranchiata

Family CYCLOPHORIDAE

Genus CYCLOPHORUS Montfort 1810

Cyclophorus punctatus (Grateloup 1841)

Cyclophorus punctatus Yen, Bull. Geol. Soc. China, XV(3), p. 338, 1936.

This species was described in living state from Ceylon, and it occurs commonly in southern and southeastern Asia.

Horizon and locality.—Para-loess formation, upper Pleistocene; Pahsien, Eastern Szechwan.

Cyclophorus exaltatus youngi Yen 1936

Cyclophorus youngi Yen, Bull. Geol. Soc. China, XV(3), p. 339, pl. 1, fig. 4.

Horizon and locality.—Same as the preceding species.

Cyclophorus martensianus Moellendorff 1874

Cyclophorus pallens Heude, Hsu, Palaeontologia Sinica, B, VI(3), p. 37, pl. 3, figs. 1-2, 1936.

This is a common species occurring along the Yangtze valley. The typical form of *C. pallens* Heude was based on some minor form of this species from lower Yangtze, but the size of intermediate forms has been recorded.

Horizon and locality.—Para-loess formation, upper Pleistocene; Lungtan, Kiangsu.

Genus DIPLOMMATINA Benson 1849

Diplommatina pupinella Heude 1885

Diplommatina pupinella Heude, Hsu, Ibidem, p. 35, pl. 2, figs. 23-26, 1936.

Horizon and locality.—Same as the preceding species.

Family VIVIPARIDAE

Genus VIVIPARUS * Montfort 1810

Viviparus chinensis (Gray 1834)

Vivipara cf. *lecythoides* Benson, Hsu, Palaeontologia Sinica, B, VI(2), p. 32, pl. 3, figs. 2-5, 1935.

Recently I have illustrated the types of both *V. chinensis* (Gray) and *V. c. lecythoides* (Benson); the former was described from south China (while its collector, Reeves, spent most of his time around Canton), and the latter was well known from east China.

Horizon and locality.—Post Pleistocene, Kweilin cave; Kweilin, Kwangsi.

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* For generic status of first four forms recorded here, which are represented in the living fauna, refer to my paper on Chinese Viviparidae (Nautilus 56(4), pp. 124-130, 1943), 10 species recorded from Pliocene beds are included here in *Viviparus* (*sensu lato*).

Viviparus lecythoides occidentalis (Annandale 1924)

Vivipara leei Hsu, Ibidem, p. 35, pl. 3, figs. 11-13.
Vivipara leei var. *distincta* Hsu, Ibidem, p. 37, pl. 4, figs. 2-6.
Vivipara leei var. *convexa* Hsu, Ibidem, p. 38, pl. 4, fig. 7.
Vivipara kweilinensis Hsu, Ibidem, p. 39, pl. 4, fig. 8.

Based on the slight difference in elevation of the spire, hence also difference in proportion of the altitude to width of the shell, as well as some variable degree in the development of spiral sculpture, Hsu described the above species and varieties, which seem all to belong to this species that Annandale described from Yunnan, and he considered it to be related with *V. malleata* (Reeve). The size of *Viviparus* is not of much specific or even varietal value, as it is well known that the females usually have larger shells.

Horizon and locality.—Same as the preceding species.

Viviparus quadratus (Benson 1842)

Vivipara quadrata Odhner, Palaeontologia Sinica, B, VI(4), p. 27, 1930.
Bithinia viviparoides Hsu, Palaeon. Sinica, B, VI(3), p. 32, pl. 2, fig. 19.

This is a very common species occurring throughout the country. *B. viviparoides* Hsu is only a young form of this species which can be easily recognized by its outline, peripheral keel, and peristomal margin from a species of *Bithynia* (=*Bulimus*). *Viviparus angularis* Mueller (recorded by Schlosser 1906, S. 394, from high river bank of Sieho, Hupei province) may also belong to this species.

Horizon and locality.—Upper Pleistocene; Maping (Liuchow), Kwangsi and Maoshan, Chuyung, Kiangsu.

Viviparus quadratus limnophilus (Mabille 1886)

Viviparus dispiralis Heude, Hsu, Palaeon. Sinica, B, VI(2), pl. 33, figs. 3-6, 1935.

The whorls of *V. q. dispiralis* (Heude) are much more roundly convex and the peripheral keel is scarcely visible. Hsu's specimens seem to agree better with this subspecies which was described from Lake Tali of Yunnan.

Horizon and locality.—Post Pleistocene; Kweilin, Kwangsi.

Viviparus margaryaeformis Mansuy 1918

Vivipara margaryaeformis Mansuy, Bull. Surv. Geol. Indochine, V(3), p. 3, pl. 1, figs. 1-8; pl. 2, figs. 1-3.

This species is narrowly oblong in outline and gradually tapering towards the apical part. It seems to be related to some of the highly elevated forms of the preceding species.

Horizon and locality.—Upper Pliocene; Mongtze, Yunnan.

Viviparus tingi Yen 1935

Viviparus tingi Yen, Bull. Geol. Soc. China, XIV(3), p. 316, pl. 1, fig. 1.

Horizon and locality.—Upper Pliocene; west of Tseying, Chutsing, Yunnan.

Viviparus wangi Yen 1935

Viviparus wangi Yen, Ibidem, p. 318, pl. 1, fig. 2.

Horizon and locality.—Same as the preceding species.

Viviparus chutsingensis Yen 1935

Viviparus chutsingensis Yen, Ibidem, p. 319, pl. 1, fig. 3.

Horizon and locality.—Same as the preceding species.

Viviparus tulotomoides Yen 1935

Viviparus tulotomoides Yen, Ibidem, p. 320, pl. 1, fig. 5.

Horizon and locality.—Same as the preceding species.

Viviparus kwangsiensis (Hsu 1935)

Tulotoma kwangsiensis Hsu, Palaeontologia Sinica, B, VI(2), p. 13, pl. 1, fig. 4.
Paracompeloma ovata Hsu, Ibidem, p. 24, pl. 2, figs. 5-6.

It seems to be beyond any doubt that *Paracompeloma ovata* Hsu is only a young form of this species, they represent the early whorls with its characteristic rounded carina near the suture.

Horizon and locality.—Lower Pliocene; Napo, Kwangsi.

Viviparus lii (Hsu 1935)

Tulotoma lii Hsu, Palaeontologia Sinica, B, VI(2), p. 15, pl. 1, figs. 5-7.

Horizon and locality.—Same as the preceding species.

Viviparus lii parvius (Hsu 1935)

Tulotoma lii var. *parva* Hsu, Ibidem, p. 17, pl. 1, fig. 8.

Horizon and locality.—Same as the preceding species.

This form and the preceding two species were described as *Tulotoma,* with which I am unable to trace important congeneric features, even the sculpture is also different in kind. The species of *Tulotoma* bear one or more spiral series of carinae or tubercles, while the present series of specimens are roundly carinated near the suture with or without one or more faint spiral lines. They appear to resemble some of the species from Vienna and Rumanian basins, which are considered to belong to *Viviparus.*

Wenz in 1939 proposed a new genus, *Tulotomoides,* for these species.

"Tulotoma" gigas Odhner 1930

Tulotoma gigas Odhner, Palaeontologia Sinica, B, VI(4), p. 13, pl. 3, fig. 19.

According to Odhner's descriptions and illustration, this species seems to agree well with *Kwangspira accelerata* Hsu, and it is highly probable that this form may belong to that genus.

Viviparus wongi Yen 1936

Viviparus wongi Yen, Bull. Geol. Soc. China, XV(4), p. 501, pl. 1, fig. 2.

Horizon and locality.—Lower Pliocene; Yungning, Kwangsi.

Genus **MARGARYA** Nevill 1877

Margarya melanoides mansuyi Dautzenberg et Fischer 1905

Margarya melanoides var. *mansuyi* Mansuy, Bull. Surv. Geol. Indochine, V(3), p. 4, pl. 1, figs. 9-11; pl. 2, figs. 7-8, 1918.
Margarya melanoides var. *mansuyi* Yen, Bull. Geol. Soc. China, XIV(3), p. 321, pl. 2, fig. 4, 1935.

Horizon and locality.—Upper Pliocene; Mongtze and near Lake Kuming, Yunnan.

Family AMPULLARIDAE

Genus KWANGSISPIRA Hsu 1935

Kwangsispira accelerata Hsu 1935

Kwangsispira accelerata Hsu, Palaeontologia Sinica, B, VI(2), p. 10, pl. 1, figs. 1-3.

Horizon and locality.—Lower Pliocene; Napo, Kwangsi.

Kwangsispira grabaui Hsu 1935

Kwangsispira grabaui Hsu, Ibidem, p. 12, pl. 2, fig. 1.

Horizon and locality.—Lower Pliocene, Napo, Kwangsi.

Family VALVATIDAE

Genus VALVATA Müller 1774

Valvata piscinalis (Müller 1774)

Valvata piscinalis Schlosser, Ann. Hist. nat. Mus. Hungarici, 4, S. 390, Taf. 10, figs. 29-31.

Horizon and locality.—Upper Pliocene; West of Quetä, Kansu.

Valvata species

Valvata species, Odhner, Palaeontologia Sinica, B, VI(4), p. 25, pl. 3, fig. 36.

Horizon and locality.—Lower Pliocene; Nanning (Yungning), Kwangsi.

Family HYDROBIIDAE

Genus PYRGULA Cristofori et Jan 1832

Pyrgula sinensis Odhner 1930

Pyrgula sinensis Odhner, Palaeontologia Sinica, B, VI(4), p. 24, pl. 3, fig. 35.

Horizon and locality.—Lower Pliocene; Nanning (Yungning), Kwangsi.

Genus STALIO Brusina 1870

Stalio gregaria (Bronn 1829)

Cyclostoma gregaria Bronn, Zeitschrift Min., 1, S. 75, 1829.
Euchilus deschiensianum Deshayes, Odhner, Bull. Geol. Surv. China, 4, p. 128, pl. 1, figs. 9-11, 1921.

Horizon and locality.—Upper Eocene; Yuanchu, Shansi.

Genus **ONCOMELANIA** Gredler 1881

Oncomelania species

Oncomelania species Odhner, Palaeontologia Sinica, B, VI(4), p. 24, pl. 3, fig. 27.

Horizon and locality.—Same as the preceding species.

Genus **STENOTHYRA** Benson 1856

Stenothyra fasciolata Odhner 1930

Stenothyra fasciolata Odhner, Palaeontologia Sinica, B, VI(4), p. 22, pl. 3, fig. 33.

Horizon and locality.—Same as the preceding species.

Stenothyra supracarinata Odhner 1930

Stenothyra supracarinata Odhner, Palaeontologia Sinica, B, VI(4), p. 23, pl. 3, fig. 34.

Horizon and locality.—Same as the preceding species.

Stenothyra parviglobosa (Hsu 1935)

Nematura parviglobosa Hsu, Palaeontologia Sinica, B, VI(2), p. 31, pl. 3, figs. 9-11.

Horizon and locality.—Lower Pliocene; Napo, Kwangsi.

Stenothyra ovata Odhner 1930

Stenothyra ovata Odhner, Palaeontologia Sinica, B, VI(4), p. 20, pl. 3, fig. 24.

Horizon and locality.—Lower Pliocene; Nanning, Kwangsi.

Genus **GANGETIA** Ancey 1891

Gangetia rissoides (Odhner 1930)

Stenothyra (*Gangetia*) *rissoides* Odhner, Palaeontologia Sinica, B, VI(4), p. 19, pl. 3, figs. 20-21.

Horizon and locality.—Lower Pliocene; Nanning, Kwangsi.

Gangetia rissoides minor (Odhner 1930)

Stenothyra (*Gangetia*) *rissoides* var. *minor* Odhner, l. c., p. 19, pl. 3, fig. 22.

Horizon and locality.—Same as the preceding species.

Gangetia brevis Odhner 1930

Stenothyra (*Gangetia*) *brevis* Odhner l. c., p. 19, pl. 3, fig. 23.

Horizon and locality.—Same as the preceding species.

"Stenothyra" gibbula Odhner 1930

Stenothyra (*Gangetia*) *gibbula* Odhner, l. c., p. 20, pl. 3, fig. 25.

Horizon and locality.—Same as the preceding species.

"Stenothyra" percarinata Odhner 1930

Stenothyra (*Gangetia*) *percarinata* Odhner, l. c., p. 20, pl. 3, fig. 32.

Horizon and locality.—Same as the preceding species.

"Stenothyra" costellata Odhner 1930

Stenothyra (*Gangetia*) *costellata* Odhner l. c., p. 21, pl. 3, figs. 26-27.

Horizon and locality.—Same as the preceding species.

"Stenothyra" marginata Odhner 1930

Stenothyra (*Gangetia*) *marginata* Odhner, l. c., p. 21, pl. 3, figs. 28-29.

Horizon and locality.—Same as the preceding species.

"Stenothyra" scala Odhner 1930

Stenothyra (*Gangetia*) *scala* Odhner, l. c., p. 22, pl. 3, figs. 30-31.

Horizon and locality.—Same as the preceding species.

The generic position of this and its preceding four species needs further consideration. They do not seem to be congeneric with the typical *Stenothyra*, nor do they agree well with forms of *Gangetia*.

Genus PARAFOSSARULUS Annandale 1924

Parafossarulus striatulus (Benson 1842)

Fossarulus greenmani Ping, Palaeontologia Sinica, B, VI(6), p. 12, pl. 1, fig. 5, 1931.
Fossarulus exiguus Hsu, Palaeontologia Sinica, B, VI(3), p. 33, pl. 2, fig. 21, 1936.

Hsu's species was based on a young and incomplete specimen of this very common species.

Horizon and locality.—Lower Pleistocene, Fenho beds, Shansi; Upper Pleistocene, Lungtan, Kiangsu.

Genus BULIMUS Scopoli 1777

Bulimus pingi Yen 1935

Bulimus pingi Yen, Bull. Geol. Soc. China, XIV(3), p. 326, pl. 3, fig. 9.

Horizon and locality.—Upper Pliocene; West Tseying, Chutsing, Yunnan.

Bulimus kingi Yen 1935

Bulimus kingi Yen, l. c., p. 327, pl. 3, fig. 10.

Horizon and locality.—Same as the preceding species.

Bulimus cholnokyi (Schlosser 1906)

Bythinia (?) *cholnokyi* Schlosser, Ann. Hist. nat. Mus. Hungarici, 4, S. 391, taf. 10, figs. 32-39.

Horizon and locality.—Pliocene; Szan-tao-kou, "Manchuria".

Bulimus species

Bythinia species Schlosser, l. c., S. 394, taf. 10, fig. 28, 1906.

Horizon and locality.—Upper Pliocene; West of Quetä, Kansu.

Family THIARIDAE

Genus SINOMELANIA Yen 1936

Sinomelania leei Yen 1936

Sinomelania leei Yen, Bull. Geol. Soc. China, XV(4), p. 499, pl. 1, fig. 1.

Horizon and locality.—Lower Pliocene; Yungning, Kwangsi.

Genus SEMISULCOSPIRA Boettger 1886

Semisulcospira napoensis (Hsu 1935)

Melania aubriyana var. *napoensis* Hsu, Palaeontologia Sinica, B, VI(4), p. 26, pl. 2, figs. 7-8.

It seems to resemble in general shape as well as in sculpture the living species *S. lauta* (Fulton 1904), which was originally described from Yunnan.

Horizon and locality.—Lower Pliocene, Napo, Kwangsi.

Genus MELANOIDES Olivier 1804

Melanoides tungkwanensis (Ping 1931)

Melanoides tungkwanensis Ping, Palaeontologia Sinica, B, VI(6), p. 14, pl. 1, fig. 6.

Horizon and locality.—Pliocene; Tungkwan, Shensi.

Genus BROTIA H. Adams 1866

Brotia swinhoei (H. Adams 1870)

Melania swinhoei Odhner, Palaeontologia Sinica, B, VI(4), p. 28, 1930.

Horizon and locality.—Upper Pleistocene; Maping (Liu-chow), Kwangsi.

"Melania" hsuiana nom. nov.

Melania turrita Hsu, Palaeontologia Sinica, B, VI(4), p. 28, pl. 3, fig. 1, 1935—non Klein 1846.

This species appears to be a thalassoid form.

Horizon and locality.—Lower Pliocene; Napo, Kwangsi.

PULMONATA

Basommatophora

Family PHYSIDAE

Genus APLEXA Fleming 1820

Aplexa cf. **pulchella** (Orbigny 1850)

Physa cf. *lamberti* Deshayes, Odhner, Bull. Geol. Surv. China, 4, p. 127, pl. 1, figs. 5-6, 1921.

According to Wenz and others *Physa lamberti* Deshayes is a synonym of this species.

Horizon and locality.—Upper Eocene; Yuanchu, Shansi.

Family LYMNAEIDAE

Genus RADIX Montfort 1810

Radix lagotis (Schrank 1803)

Limnaeus grabaui Ping, Palaeontologia Sinica, B, VI(6), p. 8, pl. 1, fig. 2, 1931.

Horizon and locality.—Lower Pleistocene, Sanmenian; Fenho, Shansi.

Radix plicatulus (Benson 1842)

Limnaeus teilhardi Ping, Ibidem, p. 10, pl. 1, fig. 3, 1931.
Succinea niangtzeiensis Ping, Ibidem, p. 24, pl. 2, figs. 12a, b, 1931.

There seems to be little doubt that *Succinea niangtseiensis* Ping is a form of *Lymnaea*, probably belonging to this species. Besides the illustrations, Ping described its " inner lip reflected in its lower half which forms the produced and curved columella ", and it is also said that its umbilicus is narrow and slit-like, almost covered by the columella. These characters are not congeneric with forms of *Succinea*.

Horizon and locality.—Lower Pleistocene, Sanmenian; Tatung and Niangtzekwan, Shansi.

Radix clessini (Neumayr 1898)

Limnaea clessini Odhner, Palaeontologia Sinica, B, VI(1), p. 16, 1925.

Horizon and locality.—Lower Pleistocene; Hotitsun, Yuanchu, Shansi.

Radix shansiensis (Ping 1931)

Limnaeus shansiensis Ping, Ibidem, p. 11, pl. 1, fig. 4, 1931.

It seems to resemble some of the high-spired species of *Radix* such as *R. hookeri* (Reeve) and *R. cucunorica* (Moellendorff) from the lakes of Tibet and Tsinghai, having but a more exserted spire.

Horizon and locality.—Lower Pleistocene, Sanmenian; northwestern Shansi.

Radix aff. **ovatus** (Müller 1774)

Limnaeus aff. *ovatus* Schlosser, Ann. Hist. nat. Mus. Hungarici, 4, S. 377, taf. 10, fig. 11, 1906.

Horizon and locality.—Pliocene, Plateau edge of Hoangho, near Quetä, Kansu.

Radix aff. **peregra** (Müller 1774)

Limnaeus aff. *peregra* Schlosser, l. c., S. 379, taf. 10?, figs. 9-10, 1906.

Horizon and locality.—Same as the preceding species.

Genus **GALBA** Schrank 1803

Galba pervia (Martens 1867)

Succinea tenuis Ping, Palaeontologia Sinica, B, VI(5), p. 21, pl. 2, figs. 12a, b, c, 1929.

According to Ping's description and illustrations, the whorls are roundly convex and shouldered, columella slightly reflected, umbilicus pyriform and fairly conspicuous, which seem to agree well with this species still existing commonly in north China.

Horizon and locality.—Lower Pleistocene; Chou-kou-tien, Hopei.

" Limnaeus " species

Limnaeus species Schlosser, Ann. Hist. nat. Mus. Hungarici, 4, S. 378, 1906.

Horizon and locality.—Pliocene, near Quetä, Kansu.

Family PLANORBIDAE

Genus PSEUDOPHYSA Yen 1938

Pseudophysa grabaui (Yen 1935)

Aplexa grabaui Yen, Bull. Geol. Soc. China, XIV(3), p. 322, pl. 3, fig. 6.

Horizon and locality.—Upper Pliocene; West Tseying, Chutsing Yunan.

Pseudophysa grabaui brevispira (Yen 1935)

Aplexa grabaui brevispira Yen, l. c., p. 324, pl. 3, fig. 7, (same horizon).

Pseudophysa cylindrica (Yen 1935)

Aplexa cylindrica Yen, l. c., p. 325, pl. 3, fig. 8.

Horizon and locality.—Same as the preceding species.

Genus PLANORBINA Haldeman 1842

Planorbina pseudoammonius (Schlotheim 1820)

Helicites pseudoammonius Schlotheim, Die Petrefaktenkunde etc., S. 101.
Planorbis pseudammonius Odhner, Bull. Geol. Surv. China, 4, p. 125, pl. 1, figs. 1-4, 1921.

Horizon and locality.—Upper Pliocene; West Tseying, Chutsing

Planorbina pseudoammonius leymeriei (Deshayes 1863)

Planorbis leymeriei Deshayes, Description des Animaus sans Vertébres du bassin de Paris II, p. 739, pl. 46, figs. 1-4, 1863.
Planorbis pseudammonius var. *leymeriei* Odhner, l. c., p. 126, 1921.

Horizon and locality.—Same as the preceding species.

Planorbina sparnacensis (Deshayes 1824)

Planorbis sparnacensis Deshayes, Description des Coquilles fossiles des environs de Paris II, p. 86, pl. 10, figs. 6-7.
Planorbis aparnecensis Odhner, l. c., p. 126, pl. 1, figs. 7, 7a, 1921.

Horizon and locality.—Same as the preceding species.

Genus GYRAULUS Agassiz 1837

Gyraulus sibericus (Dunker 1848)

Planorbis chihliensis Ping, Palaeontologia Sinica, B, VI(5), p. 14, pl. 1, fig. 7, 1929; Ibidem, B, VI(6), p. 6, pl. 1, fig. 1, 1931.

Horizon and locality.—Lower Pleistocene; Chou-kou-tien, Hopei; Lower Pleistocene, Sanmenian; Tangshan, Hopei and Tatung et Fenho, Shansi.

Gyraulus species

Planorbis (*Gyraulus*) species Schlosser, Ann. Hist. nat. Mus. Hungarici, 4, S. 388, taf. 10, fig. 17, 1906.

Horizon and locality.—Pliocene; Plateau edge of Hoangho, west of Quetä, Kansu.

Genus **HIPPEUTIS** Agassiz 1837

Hippeutis chertieri (Deshayes 1863)

Planorbis chertieri Deshayes, Description des Animaux sans Vertébres du bassin de Paris II, p. 753, pl. 46, figs. 5-8.
Planorbis chertieri Odhner, Bull. Geol. Surv. China, 4, p. 126, pl. 1, fig. 8, 1921.

Horizon and locality.—Upper Eocene; Yuanchu Hsien, Shansi.

Genus **PLANORBIS** Müller 1774

Planorbis sinensis Odhner 1921

Planorbis sinensis Odhner, Bull. Geol. Soc. China, 4, p. 127, pl. 1, figs. 12-15, 1921.

This species seems to belong to the group *Indoplanorbis* Annandale and Prashad 1920.

Horizon and locality.—Same as the preceding species.

" Planorbis " species

Planorbis (*Gyrorbis*?) species Schlosser, Ann. Hist. nat. Mus. Hungarici, 4, S. 386, taf. 10, fig. 26, 1906.

Horizon and locality.—Pliocene; Plateau edge of Hoangho, west of Quetä, Kansu.

" Planorbis " species

Planorbis species Schlosser, l. c., S. 385, taf. 10, figs. 20-21, 1906.

Horizon and locality.—Pliocene; Han-ahi, west of Quetä, Kansu.

Stylommatophora

Family **SUCCINEIDAE**

Genus **SUCCINEA** Draparnaud 1801

Succinea oblonga Draparnaud 1801

Succinea oblonga Hilber, SB. Akad. Wissensch. Wien, 88, S. 1379, taf. 6, figs. 13, 14, 1884.

This is probably *Succinea chinensis erythrophana* Ancey 1883, with which *Succinea elegans* Ping 1931 seems to be also identical.

Horizon and locality.—Upper Pleistocene, Loess; Kung-chang-fu, Kansu.

Succinea evoluta Martens 1882

Succinea evoluta Sturany, Denksch. Akad. Wissensch. Math.-Naturwis. Wien, 70, S. 37, 1901.

Horizon and locality.—Upper Pleistocene, Loess; left side of Tungho, S. W. Shansi.

Succinea altaica Martens 1882

Succinea (*Lucena*) *altaica* Andraea, in Futterer's Durch Asien, III, S. 73, 1903.
Succinea debilis Ping, Palaeontologia Sinica, B, VI(5), p. 19, pl. 2, fig. 11, 1929.

Horizon and locality.—Upper Pleistocene, Loess; between Kung-chang and Chinchao-yi, W. Kansu; Lower Pleistocene, Chou-kou-tien, Hopei.

Succinea pfeifferi Rossmaessler 1835

Succinea hopeiensis Ping, Palaeontologia Sinica, B, VI(6), p. 27, pl. 2, fig. 14, 1931.

Horizon and locality.—Upper Pleistocene; Niangtzekwan, Shansi.

Family COCHLICOPIDAE

Genus COCHLICOPA Risso 1826

Cochlicopa lubrica (Müller 1774)

Cochlicopa lubrica Andraea, in Futterer's Durch Asien III, S. 70, 1903.
Opeas lata Ping, Palaeontologia Sinica, B, VI(6), p. 28, pl 2, fig. 15, 1931.

Horizon and locality.—Upper Pleistocene; Chung-pu-ssa, Shansi; Lower Pleistocene, Chou-kou-tien, Hopei.

Cochlicopa sinense (Heude 1890)

Opeas lata Ping, Palaeontologia Sinica, B, VI(5), p. 23, pl. 2, figs. 14a, b, 1929.

Horizon and locality.—Lower Pleistocene, Chou-kou-tien, Hopei.

Family PUPILLIDAE

Genus PUPILLA Leach 1831

Pupilla muscorum (Linné 1758)

Pupa (Pupilla) muscorum Hilber, S.B. Akad. Wissensch. Wien, 88, S. 1376, taf. 6, fig. 9, 1884.
Pupa (Pupilla) muscorum var. *edentula* Slavik, Andraea in Futterer's Durch Asien III, S. 70, 1903.

Horizon and locality.—Upper Pleistocene, Loess; Kung-chang-fu, Kansu, and between Kung-chang-fu and Chin-chao-yi, W. Kansu.

Pupilla cupa turcmenia (Boettger 1889)

Pupa (Pupilla) cupa var. *turcmenia* Andraea, in Futterer's Durch Asien III, S. 71, fig. 2, 1903.

Horizon and locality.—Upper Pleistocene, Loess; between Kung-chang-fu and Chin-chao-yi, Kansu.

Pupilla signata (Mousson 1873)

Pupa (Pupilla) signata Andraea, in Futterer's Durch Asien III, S. 31, fig. 1, 1903.

Horizon and locality.—Upper Pleistocene, Loess; Tung-fan-yi, W. Kansu.

Pupilla chinensis (Hilber 1884)

Pupa (Pupilla) chinensis Hilber, SB. Akad. Wissensch. Wien, 88, S. 1378, taf. 6, fig. 11, 1884.

Horizon and locality.—Upper Pleistocene, Loess; Lan-chow-fu, Kansu.

Pupilla richthofeni (Hilber 1884)

Pupa (Pupilla) richthofeni Hilber, SB. Akad. Wissensch. Wien, 88, S. 1379, taf. 6, fig. 12.

Horizon and locality.—Upper Pleistocene, Loess; Huai-ning-hsien, Kansu.

Pupilla aeoli (Hilber 1884)

Pupa (Pupilla) aeoli Hilber, SB. Akad. Wissensch. Wien, S. 1377, taf. 6, fig. 10, 1884.

Horizon and locality.—Same as the preceding species.

Pupilla hopeiensis (Ping 1929)

Pupa hopeiensis Ping, Palaeontologia Sinica, B, VI(5), p. 11, pl. 1, fig. 5.

Horizon and locality.—Lower Pliocene, Red clay of Sheuh-hwa-shan; Chingshing, Hopei.

Pupilla grabaui (Ping 1929)

Pupa grabaui Ping, Palaeontologia Sinica, B, VI(5), p. 10, pl. 1, fig. 3.

This is a sinistral species of *Pupilla*.

Horizon and locality.—Same as the preceding species.

Genus **TRUNCATELLINA** Lowe 1852

Truncatellina micra (Ping 1929)

Pupa micra Ping, Palaeontologia Sinica, B, VI(5), p. 18, pl. 2, fig. 10, 1929.

Horizon and locality.—Lower Pleistocene, Chou-kou-tien, Hopei.

Genus **MICROSTELE** Boettger 1886

Microstele pingi Pilsbry 1934

Pupa subconica Ping, Palaeontologia Sinica, B, VI(5), p. 11, pl. 1, fig. 4, 1929 (non Sandberger 1858).

Microstele pingi Pilsbry, Man. Conch., Ser. 2, 28, p. 137.

The distribution of this genus ranges from India and Ceylon, east and southwest of Africa, as well as Miocene of Europe.

Horizon and locality.—Same as the preceding species.

Genus **COLUMELLA** Westerlund 1878

Columella columella (Benz 1830)

Pupa (Sphyradium) columella Andraea, in Futterer's Durch Asien III, S. 72, 1903.

Horizon and locality.—Upper Pleistocene, Loess; between Kum-bum and Tan-kar-ting, W. Kansu.

Family VALLONIIDAE

Genus **VALLONIA** Risso 1826

Vallonia tenera (Reinhardt 1877)

Vallonia tenera Andraea, in Futterer's Durch Asien III, S. 70, 1903.

Horizon and locality.—Upper Pleistocene, Loess; between Kung-chang-fu and Chin-chao-yi, W. Kansu.

Vallonia pulchellula (Heude 1882)

Vallonia pulchellula Yen, Bull. Geol. Soc. China, XV(3), p. 336.

Horizon and locality.—Upper Pleistocene; Pahsien, East Szechwan.

Vallonia ladacensis tibetana Moellendorff 1899

Vallonia ladacensis var. *tibetana* Andraea, in Futterer's Durch Asien III, S. 69, 1903.

Horizon and locality.—Upper Pleistocene, Loess; between Kung-chang-fu and Chin-chao-yi, W. Kansu.

Vallonia cf. **declivis** var. **altilis** Sterki 1892

Vallonia cf. *declivis* var. *altilis* Andraea, in Futterer's Durch Asien III, S. 69.

Horizon and locality.—Upper Pleistocene, Loess; Tan-kar-ting, near Chin-chao-yi, W. Kansu.

Vallonia hipparionum (Ping 1929)

Helix hipparionum Ping, Palaeontologia Sinica, B, VI(5), p. 9, pl. 1, fig. 2, 1929.

Horizon and locality.—Lower Pliocene, Red Clay of Shueh-hwa-shan; Chingshing, Hopei.

"**Helix (Vallonia?)** species"

Helix (*Vallonia*?) species Schlosser, Ann. Hist. nat. Mus. Hungarici, 4, S. 389, taf. 10, fig. 27.

Judging by the illustration and notes by Schlosser, it does not seem to be a species of *Vallonia,* as the whorls increase rather closely and gradually. It appears to belong to Zonitidae.

Horizon and locality.—Pliocene; Plateau edge of Hoangho, West of Quetä, Kansu.

Family **ENIDAE**

Genus **MIRUS** Albers 1850

Mirus cantori (Philippi 1844)

Buliminus cantori Hsu, Palaeontologia Sinica, B, VI(3), p. 27, pl. 2, figs. 14-16, 1936.

Horizon and locality.—Upper Pleistocene; Lungtan and Chiao-shan, Kiangsu.

Mirus funiculoides (Hsu 1936)

Buliminus funiculoides Hsu, l. c., p. 29, pl. 2, fig. 17.

This is a sinistral species of *Mirus.*

Horizon and locality.—Upper Pleistocene; Lungtan, Kiangsu.

Mirus euonymus (Sturany 1901)

Buliminus euonymus Sturany, Denksch. Akad. Wissensch. Math.-Naturwis. Wien, 70, S. 34, taf. 3, figs. 17-19.

Horizon and locality.—Upper Pleistocene, Loess; between Ta-ho and Yün-ning-ho, East Kansu.

Genus **SUBZEBRINUS** Westerlund 1887

Subzebrinus fuchsiana (Heude 1882)

Ena fuchsiana Yen, Bull. Geol. Soc. China, XV(3), p. 337, 1936.

Horizon and locality.—Upper Pleistocene; Pahsien, Szechwan.

Genus **CLAUSILIOPSIS** Moellendorff 1902

Clausiliopsis szechenyi (Boettger 1884)

Buliminus szechenyi Sturany, Denksch. Akad. Wissensch. Wien, S. 35, 1901.

Horizon and locality.—Upper Pleistocene, Loess; between Ta-ho and Yün-ning-ho, East Kansu.

Family **CLAUSILIIDAE**

Genus **HEMIPHAEDUSA** Boettger 1877

Hemiphaedusa heudeana (Moellendorff 1882)

Clausilia obliterata Hsu, Palaeontologia Sinica, B, VI(3), p. 25, pl. 2, figs. 7-9, 1936.

This is a common species still living in different parts of lower Yangtze valley.

Horizon and locality.—Upper Pleistocene, Lungtan, Kiangsu.

Family **SUBULINIDAE**

Genus **OPEAS** Albers 1850

Opeas filare (Heude 1882)

Opeas fragilis Ping, Palaeontologia Sinica, B, VI(5), p. 21, pl. 2, fig. 13, 1929.
Opeas fragilis Ping, Ibidem, B, VI(6), p. 29, pl. 2, fig. 16, 1931.
Opeas siashuensis Hsu, Ibidem, B, VI(3), p. 30, pl. 2, fig. 18, 1936.

Horizon and locality.—Lower Pleistocene, Chou-kou-tien, Hopei; Lower Pleistocene, Sanmenian, Tangshan, Hopei; Upper Pleistocene, Lungtan, Kiangsu.

Opeas schensiensis Sturany 1901

Opeas schensiensis Sturany, Denksch. Akad. Wissensch. Wien, S. 37, taf. 3, fig. 10, 1901.

Horizon and locality.—Upper Pleistocene, Loess; left side of Tung-ho, S. W. Kansu.

Opeas chingshingensis Ping 1929

Opeas chingshingensis Ping, Palaeontologia Sinica, B, VI(5), p. 13, pl. 1, fig. 6, 1929.

Horizon and locality.—Lower Pliocene, Red Clay of Shueh-hwa-shan; Chingshing, Hopei.

Family **ZONITIDAE**

Genus **ZONITOIDES** Lehmann 1862

Zonitoides choukoutienensis (Ping 1862)

Helix choukoutienensis Ping, Palaeontologia Sinica, B, VI (5), p. 17, pl. 2, fig. 9, 1929.

Horizon and locality.—Lower Pleistocene; Chou-kou-tien, Hopei.

Family ARIOPHANTIDAE

Genus MACROCHLAMYS Benson 1832

Macrochlamys boettgeri (Hilber 1882)

Helicarion boettgeri Ping, Palaeontologia Sinica, B, VI(6), p. 32, pl. 2, fig. 11, 1931.

Horizon and locality.—Upper Pleistocene?; Niangtzekwan, Shansi.

Macrochlamys amdoana Moellendorff 1899

Macrochlamys amdoana Andraea, in Futterer's Durch Asien III, S. 58, 1903.

Horizon and locality.—Upper Pleistocene, Loess; near Sian, Shensi.

Macrochlamys species

Macrochlamys species Yen, Bull. Geol. Soc. China, XV(3), p. 332, 1936.

Horizon and locality.—Upper Pleistocene; Pahsien, E. Szechwan.

Genus EUCONULUS Reinhardt 1883

Euconulus fulvus (Müller 1774)

Hyalina (*conulus*) cf. *fulva* Hilber, SB. Akad. Wissensch. Wien, 88, S. 1356.
Hyalina (*Trochulus*) *fulva* Andraea, in Futterer's Durch Asien III, S. 57, 1903.

Horizon and locality.—Upper Pleistocene, Loess; Sian, Wei-ho valley, Shensi; near Chin-chao-yi, W. Kansu.

Genus XESTINA Pfeffer 1878

Xestina chrysoraphe krejcii Haas 1933

Xestina chrysoraphe krejcii Yen, Bull. Geol. Soc. China, XV(3), p. 331, pl. 1, fig. 1, 1936.

Horizon and locality.—Upper Pleistocene; Pahsien, E. Szechwan.

Family PLEURODONTIDAE

Genus TRAUMATOPHORA Ancey 1887

Traumatophora trisculpta (Martens 1875)

Traumatophora trisculpta Hsu, Palaeontologia Sinica, B, VI(3), p. 10, pl. 1, figs. 1-2, 1936.

Horizon and locality.—Upper Pleistocene; Chiao-shan, Chenkiang, Kiangsu.

Traumatophora fraterminor (Gredler)

Traumatophora trisculpta Hsu (pars), l. c., p. 10, pl. 1, fig. 3, 1936.

Hsu considered his specimen, which agrees well with this species, to be the young stage of the preceding one, and he illustrated in figure 3. It is smaller in diameter and higher in altitude, obtusely angulated at periphery, but its apertural features indicate sufficiently its maturity.

Horizon and locality.—Same as the preceding species.

Genus **GANESELLA** Blanford 1863

Ganesella squamosella (Heude 1882)

Ganesella squamosella Hsu, Palaeontologia Sinica, B, VI(3), p. 12, pl. 1, figs. 4-7, 1936.
Ganesella squamosella mut. *depressa* Hsu, l. c., p. 14, pl. 1, figs. 8-10, 1936.

Horizon and locality.—Upper Pleistocene; Hsiao-shan-tau, Lungtan, Kiangsu.

Family **BRADYBAENIDAE**

Genus **BRADYBAENA** Beck 1837

Bradybaena similaris (Férussac 1821)

Eulota (Eulotella) similaris Sturany, Denksch. Akad. Wissensch. Wien, 70, S. 20, 1901.
Eulota similaris mut. *lungtanensis* Hsu, Palaeontologia Sinica, B, VI(3), p. 19, pl. 1, figs. 23, 27-31, 1936.

Horizon and locality.—Upper Pleistocene, Loess; between Ta-ho and Yün-ning-ho, E. Kansu; Hsiao-shan-tou, Lungtan, Kiangsu.

Bradybaena stimpsoni (Pfeiffer 1855)

Eulota (Eulotella) stimpsoni Sturany, l. c., S. 20, 1901.

Horizon and locality.—Upper Pleistocene, Loess; lower Tao-ho valley, Ningchow, S. Kansu.

Bradybaena ravida (Benson 1842)

Eulota ravida Hsu, Palaeontologia Sinica, B, VI(3), p. 16, pl. 1, figs. 11-12, 1936.

Horizon and locality.—Upper Pleistocene, Hsiao-shan-tou, Lungtan, and Chiao-Shan, Chenkiang, Kiangsu.

Bradybaena ravida redfieldi (Pfeiffer 1854)

Eulota (Acusta) ravida redfieldi Sturany, Denksch. Akad. Wissensch. Wien, 70, S. 19, 1901.
Eulota phragmitum Hsu, l. c., p. 18, pl. 1, figs. 14-22, 24-26, 1936.

Horizon and locality.—Upper Pleistocene; Loess, between Ta-ho and Yün-ning-ho, E. Kansu; Lungtan and Chiao-shan, Kiangsu.

Bradybaena kiangsiensis (Martens 1875)

Eulota kiangsiensis Odhner, Palaeontologia Sinica, B, VI(4), p. 28, 1930.

Horizon and locality.—Upper Pleistocene; Maping (Liu-chow), Kwangsi.

Genus **CATHAICA** Moellendorff 1884

Cathaica fasciola (Draparnaud 1801)

Cathaica fasciola Sturany, Denksch. Akad. Wissensch. Wien, S. 23, 1901.
Cathaica (Eucathaica) fasciola Andraea, in Futterer's Durch Asien III, S. 59.
Helix pyrrhozona Philippi, Ping, Palaeontologia Sinica, B, VI(5), p. 7, pl. 1, fig. 1, 1929.
Helix pyrrhozona Philippi, Ping, Ibidem, p. 15, 1929.
Eulota (Cathaica) pyrrhozona Ping, Ibidem, B, VI(6), p. 20, pl. 2, fig. 9, 1931.

Horizon and locality.—Upper Pleistocene, near Sian, Shensi; left bank of Tung-ho, S. W. Kansu; between Ta-ho and Yün-ning-ho, E. Kansu; Lower

Pleistocene, Chou-kou-tien, Hopei; Lower Pleistocene, Red Clay of Sheuh-hwa-shan, Chingshing, Hopei.

Cathaica orithyia (Martens 1879)

Cathaica orithyia Sturany, Denksch. Akad. Wissensch. Wien, 70, S. 22, 1901.
Cathaica (Pliocathaica) orithyia Andraea, in Futterer's Durch Asien III, S. 60, 1903.
Cathaica orithyia var. *conica* Andraea, Ibidem, S. 60, 1903.

Horizon and locality.—Upper Pleistocene, Loess; Yü-tau-ho and San-yung-ho, Shansi; Ching-ling-chow, Shensi; etc.

Cathaica orithyia confucii (Hilber 1883)

Helix confucii Hilber, SB. Akad. Wissensch. Wien, 86, S. 337, pl. 2, figs. 3-5.
Cathaica orithyia confucii Sturany, Denksch. Akad. Wissensch. Wien, 70, S. 24, 1901.
Cathaica orithyia var. *confucii* Andraea, in Futterer's Durch Asien III, S. 60, 1903.

Horizon and locality.—Upper Pleistocene, Loess; Kung-chang-fu, Kansu; near Han-shiu-ho village, north of Lan-chow, Kansu; between Kung-chang-fu and Chin-chao-yi, W. Kansu.

Cathaica pulveratrix (Martens 1882)

Helix pulveratrix Hilber, SB. Akad. Wissensch. Wien, 88, S. 1352, taf. 6, fig. 1, 1884.
Helix schensiensis Hilber, Ibidem, 86, S. 333, taf. 1, figs. 10-13, 1883.
Cathaica pulveratrix Sturany, Denksch. Akad. Wissensch. Wien, 70, S. 24, 1901.
Cathaica (Pliocathaica) pulveratrix Andraea, in Futterer's Durch Asien III, S. 61, 1903.
Helix schensiensis Ping, Palaeontologia Sinica, B, VI(5), p. 16, pl. 2, fig. 8, 1929.
Eulota (Cathaica) schensiensis Ping, Ibidem, B, VI(6), p. 22, pl. 2, fig. 10, 1931.

Horizon and locality.—Upper Pleistocene, Loess; Sian, Weiho valley, Sehnsi; Lou-tien-hsien, Shensi; near Liu-lu village, E. Kansu; between Yü-tou-ho and San-yung-ho, E. Kansu; Ching-ling-chow, Shensi; between Yang-chia-chwan and Li-chwan Hsien, Shensi; Lower Pleistocene, Chou-kou-tien, Hopei; etc.

Cathaica richthofeni (Martens 1873)

Helix buvigneri Deshayes, Hilber, SB. Akad. Wissensch, Wien, 86, S. 334, taf. 2, figs. 1-2, 1883.
Cathaica richthofeni Sturany, Denksch. Akad. Wissensch. Wien, 70, S. 24, 1901.
Cathaica (Pliocathaica) richthofeni Andraea, in Futterer's Durch Asien III, S. 62, 1903.

Horizon and locality.—Upper Pleistocene, Loess; Tai-futze, Shensi; Lan-chow-fu, Kansu; between Yu-tau-ho and San-yung-ho, S. Shansi; Tan-kar-ting, Kansu.

Cathaica gansuica Moellendorff 1899

Cathaica gansuica Sturany, Denksch. Akad. Wissensch. Wien, 70, S. 24, 1901.

Horizon and locality.—Upper Pleistocene, Loess; Pei-shiu-kiang, Kje-chow, S. Kansu.

Cathaica pulveratricula (Martens 1882)

Helix loczyi Hilber, SB. Akad. Wissensch. Wien, 86, S. 329, taf. 1, fig. 4, 1883.
Cathaica pulveratricula Sturany, Denksch. Akad. Wissensch. Wien, 70, S. 25, 1901.
Cathaica (Xerocathaica) pulveratricula Andraea, in Futterer's Durch Asien III, S. 65, 1903.

Horizon and locality.—Upper Pleistocene, Loess; Kung-chang-fu, Kansu; near Liu-lu village, E. Kansu; between Kung-chang and Chin-chao-yi, Kansu.

Cathaica ohlmeri Andraea 1903

Cathaica (Xerocathaica) ohlmeri Andraea, in Futterer's Durch Asien III, S. 64, taf. 1, figs. 79-81, 1903.

Horizon and locality.—Upper Pleistocene, Loess; S. E. Ku-lang-hsien, Kansu.

Cathaica holdereri Andraea 1903

Cathaica (Xerocathaica) holdereri Andraea, in Futterer's Durch Asien III, S. 64, taf. 1, figs. 74-76, 1903.

Horizon and locality.—Upper Pleistocene, Loess; E. Yi-kang-chuan, Tsinghai.

Cathaica kreitneri (Hilber 1883)

Helix kreitneri Hilber, SB. Akad. Wissensch. Wien, 86, S. 330, taf. 1, fig. 5, 1883.
Cathaica (Xerocathaica) kreitneri Andraea, in Futterer's Durch Asien III, S. 63, 1903.

Horizon and locality.—Upper Pleistocene, Loess; Ku-lang-hsien, Kansu; between Kung-chang-fu and Chin-chao-yi, Kansu.

Cathaica plectotropis (Martens 1864)

Cathaica (Pseudiberus) plectotropis Odhner, Palaeontologia Sinica, B, VI (1), p. 17, 1925.

Horizon and locality.—Lower Pleistocene, Sanmenian; Ho-ti-tsun, Yuanchu Hsian, Shansi.

Cathaica constaniae vestita Pilsbry 1934

Cathaica constaniae vestita Yen, Bull. Geol. Soc. China, XV(3), p. 334, pl. 1, fig. 3, 1936.

Horizon and locality.—Upper Pleistocene; Pahsien, E. Szechwan.

Cathaica przewalskii (Martens 1882)

Helix buddhae Hilber, SB. Akad. Wissensch. Wien, 86, S. 339, taf. 2, figs. 8-9, 1883.
Cathaica przewalskii Sturany, Denksch. Akad. Wissensch. Wien, S. 25, 1901.
Platypetasus andersoni Odhner, Palaeontologia Sinica, B, VI(1), p. 17, pl. 5, figs. 38-46. 1903

Horizon and locality.—Upper Pleistocene, Loess; Lan-chow-fu, Kansu; Tao-ho valley, Ning-chow, S. Kansu; lower Tasi-tsa-ho valley, east of Nan-shan, S. Kansu; between Kung-chang-fu and Chin-chao-yi, W. Kansu.

Genus **PLATYPETASUS** Pilsbry 1894

Platypetasus andersoni Odhner 1925

Platypetasus andersoni Odhner, Palaeontologia Sinica, B, VI(1), p. 17, pl. 5, figs. 38-46.

Horizon and locality.—Lower Pleistocene, Sanmenian; Ho-ti-tsun, Yun-achu, Shansi.

Genus **AEGISTA** Albers 1850

Aegista chinensis (Philippi 1845)

Eulota (*Aegista*) *chinensis* Hsu, Palaeontologia Sinica, B, VI(3), p. 21, pl. 2, fig. 4, 1936.

The specimen represents the young form of the species.

Horizon and locality.—Upper Pleistocene; Chiao-shan and Lungtan, Kiangsu.

Aegista pseudochinensis (Moellendorff 1884)

Eulota (*Aegista*) *chinensis* Hsu (non Philippi), Ibidem, p. 21, pl. 2, figs. 1-3, 5-6, 1936.

Horizon and locality.—Same as the preceding species.

Aegista accrescens (Heude 1882)

Aegista accrescens Yen, Bull. Geol. Soc. China, XV(3), p. 333, pl. 1, fig. 3, 1936.

Horizon and locality.—Upper Pleistocene; Pahsien, Szechwan.

Aegista accrescens initialis (Heude 1882)

Eulota (*Aegista*) cf. *vermis* Reeve, Hsu, l. c., p. 24, pl. 1, fig. 32, 1936.

The large specimen of the collection was described by Hsu as consisting of seven and one-half whorls, measuring 14.0 in diameter and 9.6 in height, which seem to agree with this subspecies originally described from Tung-liu of Anhwei. However, it does not seem to be comparable with the large-sized species *A. vermis* (Reeve), originally reported from Japan.

Genus **BULIMINOPSIS** Heude 1890

Bulminopsis subcylindrica Moellendorff 1899

Buliminopsis subcylindrica Sturany, Denksch. Akad. Wissensch. Wien, 70, S. 27, taf. 2, figs. 1-6, 1901.

Horizon and locality.—Upper Pleistocene, Pei-shiu-kiang, near Kje-chow, Kansu.

Buliminopsis buliminoides (Heude 1882)

Buliminopsis buliminoides Hsu, Palaeontologia Sinica, B, VI(3), p. 14, pl. 2, figs. 10-13, 1936.

Horizon and locality.—Upper Pleistocene; Hsiao-shan-tou, Lungtan, Kiangsu; and Chiao-shan, Chenkiang, Kiangsu.

Genus **STENOGYROPSIS** Moellendorff 1899

Stenogyropsis potanini Moellendorff 1899

Buliminopsis (Stenopyropsis) potanini Sturany, Denksch. Akad. Wissensch. Wien, S. 28, taf. 2, figs. 13-15, 1901.

Horizon and locality.—Upper Pleistocene, Loess; Pei-shiu-kiang, near Kje-chow, S. Kansu.

Genus **COCCOGLYPTA** Pilsbry 1894

Coccoglypta pinchoniana (Heude 1886)

Coccoglypta pinchoniana Yen, Bull. Geol. Soc. China, XV(3), p. 335.

Horizon and locality.—Upper Pleistocene; Pahsien, E. Szechwan.

Genus **METODONTIA** Moellendorff 1886

Metodontia houaiensis (Crosse 1882)

Helix houaiensis Hilber, SB. Akad. Wissensch. Wien, 86, S. 325, taf. 1, fig. 3, 1883.
Metodontia huaiensis Sturany, Denksch. Akad. Wissensch. Wien, 70, S. 22, 1901.
Metodontia huaiensis Andraea, in Futterer's Durch Asien III, S. 58, 1903.
Metodontia houaiensis Odhner Palaeontologia Sinica, B, VI(1), p. 17, 1925.
Hygromia (Metodontia) houaiensis Ping, Palaeontologia Sinica, B, VI(6), p. 15, pl. 1, fig. 7, 1931.

Horizon and locality.—Upper Pleistocene, Loess; Wei-ho valley, Sian, Shensi; Chung-pu-ssa, Shansi; Lao-ho, E. Kansu; near Sian, Shensi; Hoti-tsun, Yuanchu Hsien, Shansi; Tung-kwan, Shensi.

Metodontia tetrodon (Moellendorff 1875)

Hygromia (Metodontia) tetrodon Ping, Palaeontologia Sinica, B, VI(6), p. 18, pl. 2, fig. 8, 1931.

Horizon and locality.—Upper Pleistocene; Red clay at Fenho, Shansi.

PELECYPODA

Family **UNIONIDAE**

Genus **PSILUNIO** Stefanescu 1896

Psilunio tuberosus Odhner 1930

Psilunio tuberosus Odhner, Palaeontologia Sinica, B, VI(4), p. 12, pl. 2, figs. 14-18, 1930.

Horizon and locality.—Lower Pliocene; Nanning (Yungning), Kwangsi.

Psilunio ellipticus (Odhner 1930)

Rhombunio ellipticus Odhner, Ibidem, p. 9, pl. 1, figs. 4-6, 1930.

Horizon and locality.—Same as the preceding species.

Psilunio ventricosus (Odhner 1930)

Rhombunio ventricosus Odhner, Ibidem, p. 10, pl. 1, figs. 7-9, 1930.

Horizon and locality.—Same as the preceding species.

Psilunio spinifer (Odhner 1930)

Rhombunio spinifer Odhner, Ibidem, p. 11, pl. 2, figs. 10-13, 1930.
Rhombunio spinifer Leroy, Bull. Geol. Soc. China, XIX(4), p. 407, 1940.

Horizon and locality.—Same as the preceding species.

Genus **LAMPROTULA** Simpson 1900

Lamprotula antiqua Odhner 1925

Lamprotula antiqua Odhner, Palaeontologia Sinica, B, VI(1), p. 13, pl. 4, figs. 30-33; pl. 5, figs. 34-37, 1925.
Lamprotula antiqua Leroy, Bull. Geol. Soc. China, XIX(4), p. 414, 1940.

Horizon and locality.—Lower Pleistocene, Sanmenian; Ho-ti-tsun, Yuanchu, Shansi.

Lamprotula antiqua undulata Odhner 1925

Lamprotula antiqua var. *undulata* Odhner, l. c., p. 15, pl. 3, figs. 12-22; also King, Bull. Geol. Soc. China, V(2), p. 157, 1926.

Horizon and locality.—Same as the preceding species.

Lamprotula antiqua elongata King 1926

Lamprotula antiqua var. *elongata* King, Bull. Geol. Soc. China, p. 157, 1926.

Horizon and locality.—Same as the preceding species.

Lamprotula paihoensis King 1926

Lamprotula paihoensis King, l. c., p. 157; Leroy, Bull. Geol. Soc. China, XIX(4), p. 431, fig. 18, 1940.

Horizon and locality.—Upper Pleistocene, Tientsin, Hopei; Lower Pleistocene, Sanmenian, Chao-tsanu-yung-shi, Shansi.

Lamprotula tingi King 1926

Lamprotula tingi King, l. c., p. 158, 1926.

Horizon and locality.—Upper Pleistocene, Tientsin, Hopei.

Lamprotula cornuumlunae (Heude 1883)

Lamprotula cornuumlunae Odhner, Palaeontologia Sinica, B, VI(4), p. 27, 1930.

Horizon and locality.—Upper Pleistocene, Maping (Liu-chow) Kwangsi.

Lamprotula mongolica Leroy 1940

Lamprotula mongolica Leroy, Bull. Geol. Soc. China, XIX(4), p. 398, fig. 1.

Horizon and locality.—Upper Miocene, Tung-gur, Sieyuan (Inner Mongolia).

Lamprotula elegans Leroy 1940

Lamprotula elegans Leroy, l. c., p. 399, fig. 2.

Horizon and locality.—Same as the preceding species.

Lamprotula pararochechouarti Leroy 1940

Lamprotula pararochechouarti Leroy, l. c., p. 415, figs. 10-11.

Horizon and locality.—Lower Pleistocene, Sanmenian, San Men Rapids, Shansi.

Lamprotula bieni Leroy 1940

Lamprotula bieni Leroy, l. c., p. 420, fig. 14.

Horizon and locality.—Lower Pleistocene, Sanmenian, Ping-lu-hsien, Shansi.

Lamprotula licenti Leroy 1940

Lamprotula licenti Leroy, l. c., p. 425, fig. 16.

Horizon and locality.—Lower Pleistocene, Sanmenian; San-kang-ho, Shansi.

Lamprotula tungurensis (Leroy 1940)

Sulcatula tungurensis Leroy, l. c., p. 400, fig. 3.

Horizon and locality.—Upper Miocene, Tung-hur, Sie-yuan (Inner Mongolia).

Lamprotula species

Lamprotula species Leroy, l. c., p. 402, 1940.

In proposing the genus *Sulcatula* for this and the preceding forms, Loroy gave two brief lines of description with no adequate discussion of its relationship in the family. Presuming his figures for *tungurensis* are accurately produced, I see no characters of generic importance which will justify the erection of a distinct new genus.

Horizon and locality.—Same as the preceding species.

Genus **HYRIOPSIS** Conrad 1853

Hyriopsis descendens Odhner 1925

Hyriopsis descendens Odhner, Palaeontologia Sinica, B, VI(1), p. 5, pl. 3, fig. 11; Leroy, l. c., p. 411, 1940.

Horizon and locality.—Lower Pleistocene, Sanmenian; Ho-ti-tsun, Yuanchu, S. Shansi.

Hyriopsis arcidens Odhner 1930

Hyriopsis arcidens Odhner, Palaeontologia Sinica, B, VI(4), p. 6, pl. 1, figs. 1-2.

Horizon and locality.—Lower Pliocene; Nanning (Yungning), Kwangsi.

Genus **NODULARIA** Conrad 1853

Nodularia douglasiae (Gray 1834)

Nodularia douglasiae Odhner, Palaeontologia Sinica, B, VI(1), p. 7.

Horizon and locality.—Lower Pleistocene, Sanmenian; Ho-ti-tsun, Yuanchu, S. Shansi.

Nodularia triformis (Heude 1877)

Nodularia triformis Odhner, Palaeontologia Sinica, B, VI(4), p. 27, 1930.

Horizon and locality.—Upper Pleistocene, "Yellow Deposit"; Maping (Liu-chow), Kwangsi.

?**Nodularia** species

Nodularia species Leroy, Bull. Geol. Soc. China, XIX(4), p. 421, 1940.

Horizon and locality.—Lower Pleistocene, Sanmenian; Ping-lu-hsien, Shansi.

Genus **CUNEOPSIS** Simpson 1900

Cuneopsis maximus Odhner 1925

Cuneopsis maximus Odhner, Palaeontologia Sinica, B, VI(1), p. 8, pl. 2, figs. 8-11.

Horizon and locality.—Lower Pleistocene, Sanmenian; Ho-ti-tsun, Yuan-chu, S. Shansi.

Cuneopsis barbouri King 1926

Cuneopsis barbouri King, Bull. Geol. Soc. China, p. 158; Leroy, Ibidem, XIX(4), p. 424, 1940.

Horizon and locality.—Lower Pleistocene, Sanmenian; Hwai-lai, Hopei, and San-kang-ho et Nihowan, Shansi.

Cuneopsis ambiguus Leroy 1940

Cuneopsis ambiguus Leroy, Bull. Geol. Soc. China, XIX(4), p. 418, figs. 12-13.

Horizon and locality.—Lower Pleistocene, Sanmenian; San Men Rapids, Shansi.

Cuneopsis teilhardi Leroy 1940

Cuneopsis teilhardi Leroy, l. c., p. 403, fig. 5.

Horizon and locality.—Upper Miocene, Tun-gur, Sieyuan (Inner Mongolia).

Cuneopsis spocki Leroy 1940

Cuneopsis spocki Leroy, l. c., p. 404, fig. 4.

Horizon and locality.—Same as the preceding species.

Cuneopsis species

Cuneopsis species Leroy, l. c., p. 402, fig. 4.

Horizon and locality.—Same as the preceding species.

Cuneopsis tschiliensis (Sturany 1901)

Unio techiliensis Sturany, Denksch. Akad. Wissensch. Wien, 70, S. 41, taf. 4, figs. 1-6.

Horizon and locality.—Lower Pleistocene, left side of lower Kwei-ho, Chao-tao, N. Hopei.

Genus **LEPIDODESMA** Simpson 1898

Lepidodesma ponderosa Odhner 1925

Lepidodesma ponderosa Odhner, Palaeontologia Sinica, B, VI(1), p. 6, pl. 2, figs. 5-7; Leroy, Bull. Geol. Soc. China, XIX(4), p. 412, 1940.

Horizon and locality.—Lower Pleistocene, Sanmenian; Ho-ti-tsun, Yuan-chu, S. Shansi.

Genus **CRISTARIA** Schumacher 1817

Cristaria herculea (Middendorff 1848)

Cristaria hercula Odhner, l. c., p. 5, 1925.

Horizon and locality.—Lower Pleistocene, Sanmenian; Ho-ti-tsun, Yuanchu, Shansi.

Genus **ANONDONTA** Lamarck 1799

Anodonta woodiana (Lea 1834)

Anodonta woodiana Odhner, l. c., p. 4, 1925.

Horizon and locality.—Same as the preceding species.

Genus **SOLENAIA** Conrad 1868

Solanaia carinata (Heude 1877)

Solanaia carinata Odhner, l. c., p. 3, pl. 1, figs. 1-4, 1925.

Horizon and locality.—Same as the preceding species.

Family CORBICULAIDAE

Genus **CORBICULA** von Muehlfeld 1811

Corbicula fluminea (Müller 1774)

Corbicula fluminea Odhner, l. c., p. 15, pl. 4, figs. 23-28, 1925.

Horizon and locality.—Same as the preceding species.

Corbicula largillierti (Philippi 1846)

Corbicula largillierti Odhner, l. c., p. 16, 1925.

Horizon and locality.—Same as the preceding species.

Corbicula metharia Sturany 1901

Corbicula metharia Sturany, Denksch. Akad. Wissensch. Wien, 70, S. 39, taf. 4, figs. 7-11.

Horizon and locality.—Lower Pleistocene, left side of Kwei-ho, Chao-tao, N. Hopei.

Corbicula obrutschewi Sturany 1901

Corbicula obrutschewi Sturany, l. c., S. 39, taf. 4, figs. 12-16.

Horizon and locality.—Same as the preceding species.

Corbicula huailaiensis King 1927

Corbicula huailaiensis King in Grabau, Bull. Geol. Soc. China, VI, p. 238, 1927.

I have been unable to trace a description of any kind made by King. However, the species was cited by Grabau. So far as I know there is one large species of *Corbicula* commonly found in Huailai basin, which seems to agree well with the preceding species described from Hopei province.

Family SPHAERIIDAE

Genus EUPERA Bourguignat 1854

Eupera sinensis Odhner 1921

Eupera sinensis Odhner, Bull. Geol. Surv. China, 4, p. 129, pl. 1, figs. 16-22.

Horizon and locality.—Upper Eocene; Yuanchu Hsien, Shansi.

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NOTES AND DESCRIPTIONS OF NEW OR LITTLE KNOWN FISHES FROM URUGUAY

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Different small installments of fishes from Uruguay, mostly from fresh-water, were received at the Academy, during the years 1932 to 1935, sent by Dr. Florentino Felippone, of Montevideo. A number of marine fishes were sent by Sr. Luis P. Barattini, Jefe de la Estacion Oceanographica y Museo, Montevideo. These have now been identified and their labels correlated as far as possible, all totalling 276 specimens representing 49 species or subspecies. Of these 8 are described as new species and 4 as new genera or subgenera. Several of the new species are dedicated to the above mentioned donors, to whom the Academy is indebted for these generous gifts. Two known species are also described, one on account of its imperfect delineation and the other as an involved new genotype. Several references are also given for little-known species.

RAJIDAE

Psammobatis extenta (Garman)

Raia extenta Garman, Mem. Mus. Comp. Zool., vol. 36, 1913, p. 356 (on Ribeiro).

Psammobatis extenta Fowler, Arquiv. Zool. São Paulo, vol. 3, art. 6, 1941, p. 131 (reference).

Raia erinacea (not Mitchill) Ribeiro, Arch. Mus. Nac. Rio de Janeiro, vol. 14, 1907, p. 176, pls. 12-13 (type locality, Rio de Janeiro).

One, dry preparation 295 mm., from "200 millas sur-este Isla de Lobos," February 1932.

CLUPEIDAE

Clupea arcuata Jenyns

Four, 115 to 129 mm., Nueva Palmira, Rio Uruguay, Colonia, September 1933. Depth $2\frac{4}{5}$ to 3; head 4 to $4\frac{1}{4}$.

Five, 59 to 65 mm., Camara del Anceps, Montevideo, 1934. Depth $3\frac{1}{5}$ to $3\frac{2}{5}$; A. III, 17 or III, 19.

ENGRAULIDAE

Engraulis anchoita Hubbs — Figure I.

Depth $5\frac{1}{2}$ to $5\frac{3}{4}$; head $3\frac{2}{3}$ to $4\frac{1}{8}$, width $2\frac{7}{8}$ to 3. Snout 5 to $5\frac{1}{8}$ in head; eye $4\frac{3}{4}$ to $4\frac{4}{5}$, greater than snout or interorbital; maxillary reaches to angle

of preopercle, its length from snout tip $1\frac{1}{6}$ to $1\frac{1}{4}$ in head; row of fine or minute teeth along edge of each jaw; interorbital $4\frac{1}{3}$ to $4\frac{4}{5}$, low, depressed, little convex. Gill-opening extends forward opposite front edge of pupil. Gill-rakers 32 + 40, very finely and slenderly lanceolate, equal gill filaments or eye.

Scales 36 in axial lateral series, nearly all fallen so only pockets remain; about 5 transversely between dorsal and ventral origins. Paired fins each with long pointed axillary scale, and pectoral at least with 2 large basal scales. Caudal with pair of 2 large basal alar scales on each side. Scales of body rather narrowly overlap along base of anal fin at least anteriorly. Upper side of head, occiput, and humeral region venulose.

D. II, 15, first branched ray $1\frac{1}{2}$ in head; A. III, 17, first branched ray $2\frac{1}{2}$; least depth of caudal peduncle $2\frac{7}{8}$ to $3\frac{1}{8}$; caudal $1\frac{1}{8}$ to $1\frac{1}{4}$, well forked, lobes sharply pointed, equal; pectoral $1\frac{2}{3}$ to $1\frac{7}{8}$, rays 18; ventral rays 7, fin $2\frac{1}{8}$ to $2\frac{3}{7}$ in head.

Color in alcohol brown, paler below. On body a broad dark gray bandlike lateral area (evidently darkened and discolored due to preservation from its silvery white original color), ill defined though most distinct on tail and embracing base of caudal. Iris gray. Fins dull brownish, dorsal and caudal darker gray terminally.

Two, 140 to 180 mm., Punta Jose Ionacio, Maldonado, July 23, 1933.

It is with some hesitation that I accept the figure by Miss Cable, published by Hildebrand,[1] as from the $3\frac{1}{2}$ rows of scales indicated the whole count transversely would appear to amount to at least 10 or 11? This is far different from my specimens, which show only half that number between the dorsal and ventral origins. Little indication of the scalation is otherwise shown so that I feel obliged to offer the accompanying figure.

Lycengraulis olidus (Günther)

Two, 152 to 180 mm., Nueva Palmira, Rio Uruguay, Colonia, September 1933.

CHARACIDAE

CURIMATINAE

Curimata gilbert Quoy and Gaimard

One, 152 mm., Cerro Largo, Montevideo. Depth $2\frac{3}{4}$; head $3\frac{2}{3}$; D. III, 8; A. III, 6; scales 35 + 3 in lateral line.

One, 100 mm., Arroya Bornero Chico, Florida, November 1933. Depth $2\frac{4}{5}$; head $3\frac{3}{5}$; D. III, 9; A. III, 7; eye $3\frac{4}{5}$ in head.

Three, 97 to 98 mm., Arroya Carrasio, Montevideo, 1934 (Sr. Barattini).

Curimata platana Günther "Sabalito"

One, 108 mm., Rio Uruguay, Paysandu. Depth $2\frac{4}{5}$; head $3\frac{1}{5}$; D. II, 9; A. II, 7; scales 46 + 3 in lateral line.

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[1] Bull. Bingham Ocean. Coll., vol. 8, art. 2, Feb. 1943, p. 18, fig. 4 (types).

PARODONTINAE

Parodon suborbitalis Valenciennes "Virolo"

One, 98 mm., Rio Uruguay, Paysandu. D. II, 11; A. II, 6; scales 36 + in lateral line.

CHEIRODONTINAE

MEGALAMPHODUS Eigenmann

ECTREPOPTERUS new subgenus

Type.—*Megalamphodus uruguayensis* new species.

With the appearance of the subgenus *Megalamphodus* Eigenmann 1915, but differing in the absence of maxillary teeth, the postorbital in contact with the preopercle, the occipital fontanel a continuous narrow groove, besides both caudal and anal bases the chest and breast also scaled, and the upper caudal lobe shorter than the lower. In the general scalation, size of the scales, long maxillary, longer lower jaw, it agrees with *Megalamphodus.*

(*ἐκτρέπω* reverse + *πτερὸν* fin; with reference to the caudal fin.)

Magalamphodus uruguayensis new species Figures 2 (head above) and 3.

Depth $2\frac{2}{5}$; head 3, width 2. Snout $4\frac{2}{3}$ in head measured from its own tip, which is level with lower edge of pupil; eye 3, greater than snout, equals bony interorbital; maxillary large, extends half way in eye diameter, length $2\frac{1}{4}$ in head measured from snout tip; mouth short, broad, closed mandible slightly protruding in front; teeth in jaws (mandible damaged) apparently uniserial throughout, apparently 20? simple ones above and 8 large tridentate teeth in front of mandible followed by 4 simple conic teeth each side; no teeth on maxillary; bony interorbital $2\frac{7}{8}$ in head measured from snout tip, low; suborbitals largely cover cheek, leave only short narrow naked strip in front behind end of maxillary; occipital fontanel long, begins opposite front of eyes and reaches to occipital extension, last short or invading only $\frac{1}{5}$ of space to dorsal origin. Gill opening extends forward opposite front edge of pupil. Gill rakers 6 + 12, lanceolate, slender, equal gill filaments or $\frac{2}{5}$ of eye.

Scales 30 + 3 in axial lateral series, of which first 5 tubular; 5 below end of lateral line and base of ventral, 13 transversely between dorsal and anal origins; 12 predorsal forward to hind tip of supra-occipital extension. Caudal well scaled basally, though little more extensive below. At least front half of anal base with scales overlapping from body. Anterior pseudotympanum small, veiled by dark posthumeral blotch, and posterior section greatly larger, but not extended down as far as anal fin.

D. II, 9, first branched ray $1\frac{1}{5}$ in total head length; A. III, 22, first branched ray $1\frac{3}{5}$, fin without distinct lobe; least depth of caudal peduncle $2\frac{1}{2}$; caudal equals head, upper lobe little shorter, emarginate; pectoral $1\frac{4}{7}$ in head, rays I, 10; ventral rays I, 7, fin $1\frac{3}{4}$.

Color in alcohol pale brown, lighter below. Sides of both head and body with numerous, variable and inconspicuous small darker dots. A dark

humeral blotch little larger than pupil, on second to fourth scales of lateral line. A diffuse dark brown blotch, less than eye in size, at caudal base. Fins more or less uniformly pale gray-brown.

A.N.S.P., no. 70331. Uruguay. Dr. Florentino Felippone. Length 29 mm. Type.

Only the type obtained. The relationship of this species is expressed in the definition of the new subgenus described above.

(Named for Uruguay.)

PEDALIBRYCON new genus

Type.—*Pedalibrycon felipponei* new species.

Body well compressed, deeply ovoid. Head moderate. Snout short. Eye large, lateral. Maxillary short, reaches front of eye. Mouth broad, with short cleft, closed jaws even in front. Teeth in jaws rather large, strongly compressed, closely biserial above, uniserial below. Entire edge of maxillary with row of minute marginal teeth. Occipital fontanel large, well developed. Suborbitals large, entirely cover cheek. Lower gill rakers lanceolate. Scales large, well exposed. Lateral line short, only developed anteriorly as row of few short simple tubes. Caudal base scaled. Pseudotympanum distinct. Dorsal inserted medianly, fin high. Adipose fin moderate. Anal behind dorsal base, high in front. Caudal large, emarginate, lower fulcra well developed and preceded by 14 recurved graduated spines, forming a distinct keel. Pectoral low, reaches ventral. Ventral inserted before dorsal, not reaching anal.

An interesting genus approaching *Hemigrammus* in its incomplete lateral line, but otherwise greatly different in its combination of structural characters, especially the completely denticulated maxillary and spinulate keel on the lower edge of the caudal peduncle.

(πηδαλιον rudder, with reference to the lower edge of the caudal peduncle + *Brycon*.)

Pedalibrycon felipponei new species — Figues 4 (head above), 5 (lower caudal fulcra), and 6.

Depth $2\frac{1}{2}$ to $2\frac{3}{5}$; head $3\frac{4}{5}$ to $3\frac{7}{8}$, width $1\frac{3}{5}$ to $2\frac{1}{8}$. Snout $4\frac{1}{8}$ to $4\frac{1}{3}$ in head, snout tip level with middle of eye; eye $2\frac{7}{8}$ to 3, greater than snout, greater than interorbital width in smaller specimens to $1\frac{1}{4}$ in type; maxillary reaches below front eye edge, length $3\frac{1}{5}$ to $3\frac{4}{5}$ in head; mouth with short cleft, lower jaw slightly protruding (upper jaw slightly protruded in larger paratype); row of about 8 large expanded quindentate teeth above, with close-set irregular outer row of about as many smaller ones, and 8 in front of lower jaw; each maxillary edge with row of 20 minute points or denticles (only visible under a lens); interorbital width (bony) $2\frac{3}{7}$ to 3 in head measured from snout tip, low, broadly convex; suborbitals broadly and entirely cover cheek and with many fine parallel striae all along hind and lower borders broadly; occipital fontanel rather broad, begins opposite front edge of pupil and reaches into short occipital extension, which invades only $\frac{1}{7}$ of space to origin of dorsal fin. Gill opening extends forward

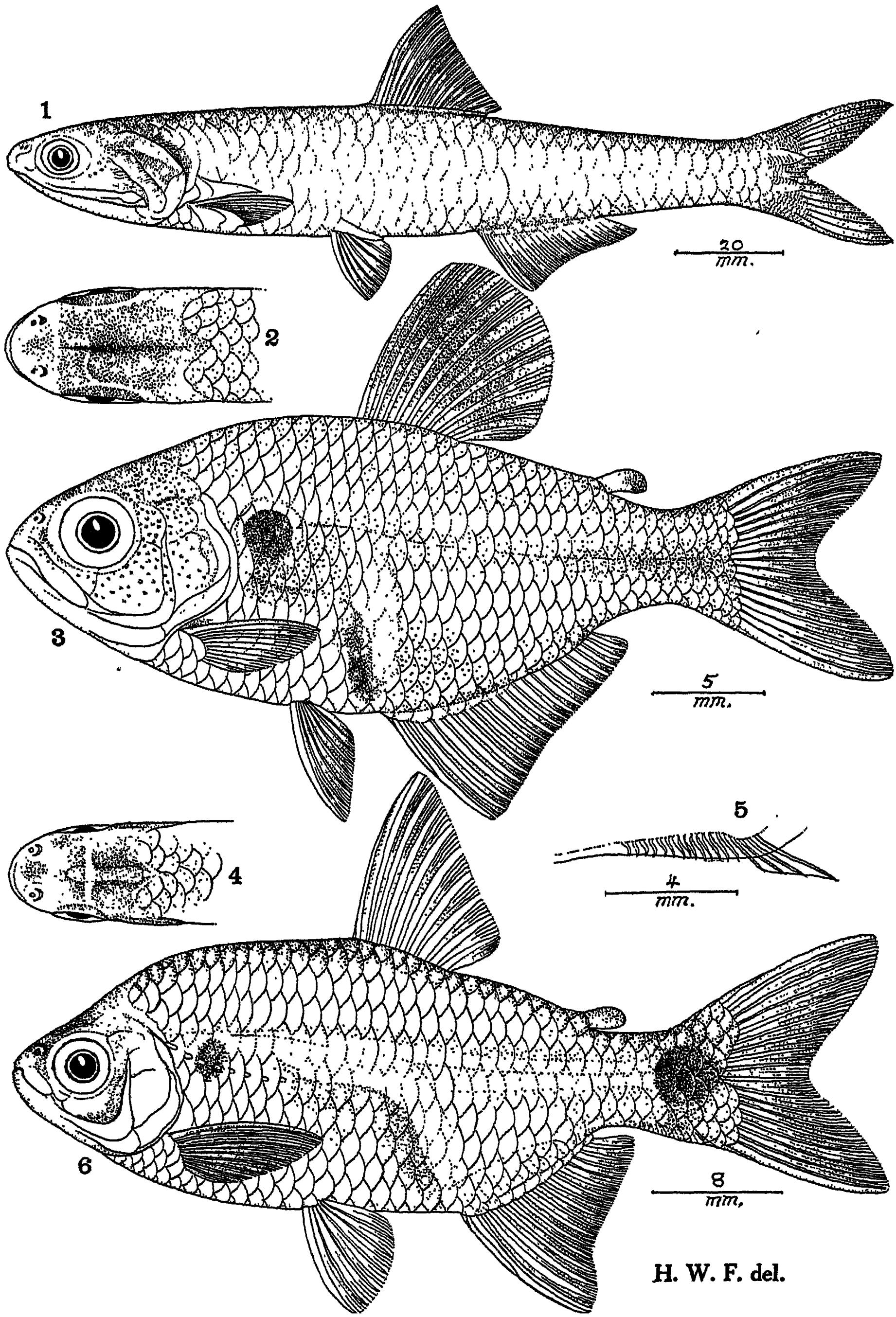

FIG. 1.—*Engraulis anchoita* Hubbs.
FIGS. 2 and 3.—*Megalamphodus uruguayensis* new species.
FIGS. 4 to 6.—*Pedalibrycon felipponei* new species.

opposite front edge of eye. Gill rakers 9 + 12, lanceolate, slender, subequal to little shorter than gill filaments, which are little shorter than eye.

Scales 30 + 3 in axial lateral series; lateral line as tube on each of 8 anterior scales; 5 scales below to ventral origin; 10 transversely between dorsal base and anal origin; 13 predorsal forward to hind end of supraoccipital extension. Caudal base broadly scaly. Row of small basal scales entire extent on anal fin. Pseudotympanum small, little less than eye, on third and fourth scales of lateral line, large posterior section extends down and usually distinct towards origin of anal.

D. II, 9, first branched ray 1 in total head length to slightly exceeding head; adipose fin $3\frac{1}{3}$ to $3\frac{1}{2}$; A. III, 16 or III, 17, first branched ray $1\frac{1}{10}$ to $1\frac{1}{3}$; least depth of caudal peduncle $1\frac{4}{5}$ to $1\frac{7}{8}$; caudal 3 in rest of fish, deeply emarginate and lower lobe little longer than upper lobe; lower caudal fulcra as 14 anterior small slightly recurved graduated spinules, occupying greater posterior part of lower edge of caudal peduncle; pectoral rays I, 9, fin $1\frac{1}{10}$ to $1\frac{1}{4}$ in total head length; ventral $1\frac{1}{4}$ to $1\frac{2}{5}$, rays I, 6.

Color in alcohol brown, pale in type, and still paler below. Sides of head and greater lower part of trunk bright silvery white. An ill-defined silvery axial band, about one scale wide and most distinct on tail and caudal peduncle. At caudal base a large rounded black blotch, subequal with eye and reflected above and below, but not out and back beyond squamous areas. An obscure gray humeral blotch on third and fourth scales of lateral line, more or less veiling pseudotympanum. Vertical fins grayish and paired fins whitish.

A.N.S.P., no. 70332. Rio Gi, Departmento del Iluranto, Uruguay. September 1934. Dr. Florentino Felippone. Length 57 mm. Type.

A.N.S.P., no. 67820. Arroyo de Malvin, Montevideo. September 1934. Dr. Felippone. Length 48 mm. Paratype.

A.N.S.P., no 67831. Arroyo Centurion, Cerro Largo. July 1932. Dr. Felippone. Length 43 mm. Paratype.

Characters expressed in the account of the genus given above.

(For Dr. Florentino Felippone, who collected the types.)

TETRAGONOPTERINAE

Astyanax fasciatus (Cuvier) "Mojara, Mojarita, Mojara Pacuza"

Six, 75 to 125 mm., Rio Uruguay, Paysandu, 1935; eleven, 34 to 62 mm., Arroyo Centurion, Cerro Largo, July 1932; two, 53 to 62 mm., Arroyo Bornero Chico, Florida, November 1933; one, 102 mm., Rio Santa Lucia, Canelones, March 1934; one, 58 mm., Arroyo de Malvin, Montevideo, May 6, 1934; also one 44 mm., same locality, September 1934; one 58 mm., Rio Gi, September 1934; two, 63 to 67 mm., Uruguay, 1935; all from Dr. Felippone.

One, 133 mm., Rio Santa Lucia, Canelones, October 18, 1935, from Sr. Barattini.

Bryconamericus iheringii (Boulenger)

Two, 53 to 58 mm., Arroyo Bornero Chico, Florida, November 1933; one, 82 mm., Rio Santa Lucia, Canelones, July 1935; one, 61 mm., Uruguay, 1935; six, 35 to 45 mm., Montevideo.

STEVARDINAE

Pseudocorynopoma doriae Perugia

Two, 59 to 77 mm., Uruguay, 1935, larger male.

CHARACINAE

Asiphonichthys stenopterus Cope

One, 90 mm., Uruguay; two, 82 to 108 mm., Rio Santa Lucia, Canelones, 1935 (Sr. Barattini). These specimens not only show a black humeral spot embracing the third to fifth scales of the lateral line, but also one above the end of it and a little smaller, besides a black basal caudal spot large as the eye.[2]

SERRASALMINAE

Serrasalmus spilopleura Kner

Two, 183 to 188 mm., Arroyo San Francisco, Paysandu, December 1933 (Sr. Barattini).

ACESTRORHYNCHINAE

Acestrorhamphus oligolepis (Steindachner)

Xiphorhamphus oligolepis Steindachner, Sitzs. Akad. Wiss. Wien, vol. 56, pt. 1, 1867, p. 339 (type locality, Rio de la Plata).

Depth $3\frac{1}{5}$ to 4; head 3 to $3\frac{1}{3}$. Snout $3\frac{1}{10}$ to 4 in head; eye 4 to $4\frac{2}{5}$, 1 to $1\frac{1}{2}$ in snout, 1 in interorbital; maxillary reaches opposite hind edge of pupil; second suborbital covers $\frac{2}{3}$ of cheek to preopercle ridge; interorbital $4\frac{1}{2}$ to $5\frac{1}{8}$ in head. Gill rakers 9 + 10. Scales 50? to 69 + 4 or 3 in lateral line, 12 to 14 above to dorsal, 7 or 8 below to ventral, 11 or 12 below to front of anal. D. II, 9; A. III, 25 to III, 27; pectoral $1\frac{1}{3}$ in head, reaches little beyond ventral base; ventral $1\frac{4}{5}$ to $1\frac{9}{10}$. Dark gray posthumeral vertical bar 4 scales deep, crosses third to fifth scales of lateral line. Plumbeous axial lateral band, dark gray at caudal base and continues behind to hind edges of median caudal rays. In larger specimen the anterior anal rays each with a row of small retrorse spinules on each outer face of the ray, quite rough to touch.

One, 107 mm., Rio Santa Lucia, Canelones, March 1934; one, 103 mm., Uruguay, 1935.

Hydrocyon falcatus Quoy and Gaimard[3] is figured with broad suborbitals more largely covering the cheek than in my specimens. As this

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[2] Proc. Acad. Nat. Sci. Phila., 1906, p. 452 (type).—Schultz, Copeia, no 4, Nov. 21, 1941, p. 271 (near Montevideo).

[3] Voy. Uranie, Zool., vol. 2, 1924, p. 221, pl. 48, fig. 2 (Rio Janeiro) (not of Bloch).

is the basis of *Hydrocyon hepsetus* Cuvier[4] I am unable to accept Cuvier's name as likely applicable to the present species.

Acestrorhamphus jenynsii (Günther)

Xiphorhamphus jenynsii Günther, Cat. Fish. Brit. Mus.. vol. 5, 1864, p. 356 (on Jenyns).
Hydrocyon hepsetus (not Cuvier) Jenyns, Zool. Voy. Beagle, pt. 4, Fish, 1842, p. 128 (type locality, Maldonado, in a fresh water lake).

Depth $3\frac{1}{8}$; head $3\frac{1}{2}$. Snout $3\frac{1}{3}$ in head; eye 4, $1\frac{1}{2}$ in snout, $1\frac{1}{4}$ in interorbital; maxillary reaches opposite hind pupil edge; second suborbital covers $\frac{3}{4}$ of cheek to preopercle ridge; interorbital $4\frac{7}{8}$ in head. Gill rakers 10 + 13. Scales 53 + 4 in lateral line; 11 above, 6 below to ventral origin, 9 below to anal origin. D. II, 9; A. III, 26. Pectoral $1\frac{2}{5}$ in head, reaches ventral origin; ventral 2. Dark posthumeral bar 4 scales deep, crosses second to fourth scales of lateral line. Plumbeous lateral band on tail, dark gray at caudal base and extends out over caudal fin to its hind edge.

One, 144 mm., Rio Santa Lucia, Montevideo (Sr. Barattini). Although Jenyns mentions *Hydrocyon hepsetus* Valenciennes[5] he fails to note the broad second suborbital covering $\frac{3}{4}$ of the cheek, a detail in complete agreement with the colored plate published by Valenciennes.

ERYTHRINIDAE

Hoplias malabaricus (Bloch) "Tararira"

One, 222 mm., Cerro Largo, Montevideo.

BUNOCEPHALIDAE

Bunocephalus bicolor Steindachner "Guitarrero"

Five, 58 to 77 mm., Rio Uruguay, Paysandu.

PIMELODIDAE

Zungaro zungaro (Humboldt)

Three, 27 to 44 mm., Arroyo Canelones, March 1933 (Dr. Felippone); one, 90 mm., Rio Santa Lucia, Canelones, October 1935 (Sr. Barattini).

Rhamdia quelen (Quoy and Gaimard) "Bagre Negro"

One, 225 mm., Cerro Largo, Montevideo.

Pimelodus maculatus Lacepede "Bagre amarillo, Bagre"

One, 310 mm., Cerro Largo, Montevideo; six, 115 to 155 mm., Rio Uruguay, Paysandu; one, 70 mm., Uruguay, from Dr. Felippone.

One, 150 mm., Santa Lucia, Canelos, October 1935, from Sr. Barattini.

Heptapterus mustelinus (Valenciennes)

One, 173 mm., Rio Santa Lucia, Canelos, July 1935.

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[4] Règne Animal, ed. 2, vol. 2, 1829, p. 512.

[5] Voy. Amér. Merid. D'Orbigny, Poiss., vol. 5, pt. 2, 1847, p. 9, pl. 9, fig. 2.

CALLICHTHYIDAE

Corydoras paleatus (Jenyns)

Three, 48 to 66 mm., Arroyo Malvin, Montevideo, 1931; one, 41 mm., Montevideo; two, 53 to 55 mm., Arroyo Carrasco, Montevideo; two, 63 to 68 mm., May 6, 1934 and four, 52 to 58 mm., Arroyo de Malvin, Montevideo, September 1934.

LORICARIIDAE

Ancistrus cirrhosus (Valenciennes)

Seven, 18 to 29 mm., Rio Santa Lucia, Canelones, March 1934. No bony plates. Rows of small points longitudinally on body.

Loricaria felipponei new species — Figures 7 (head above), 8 (head and trunk below), and 9.

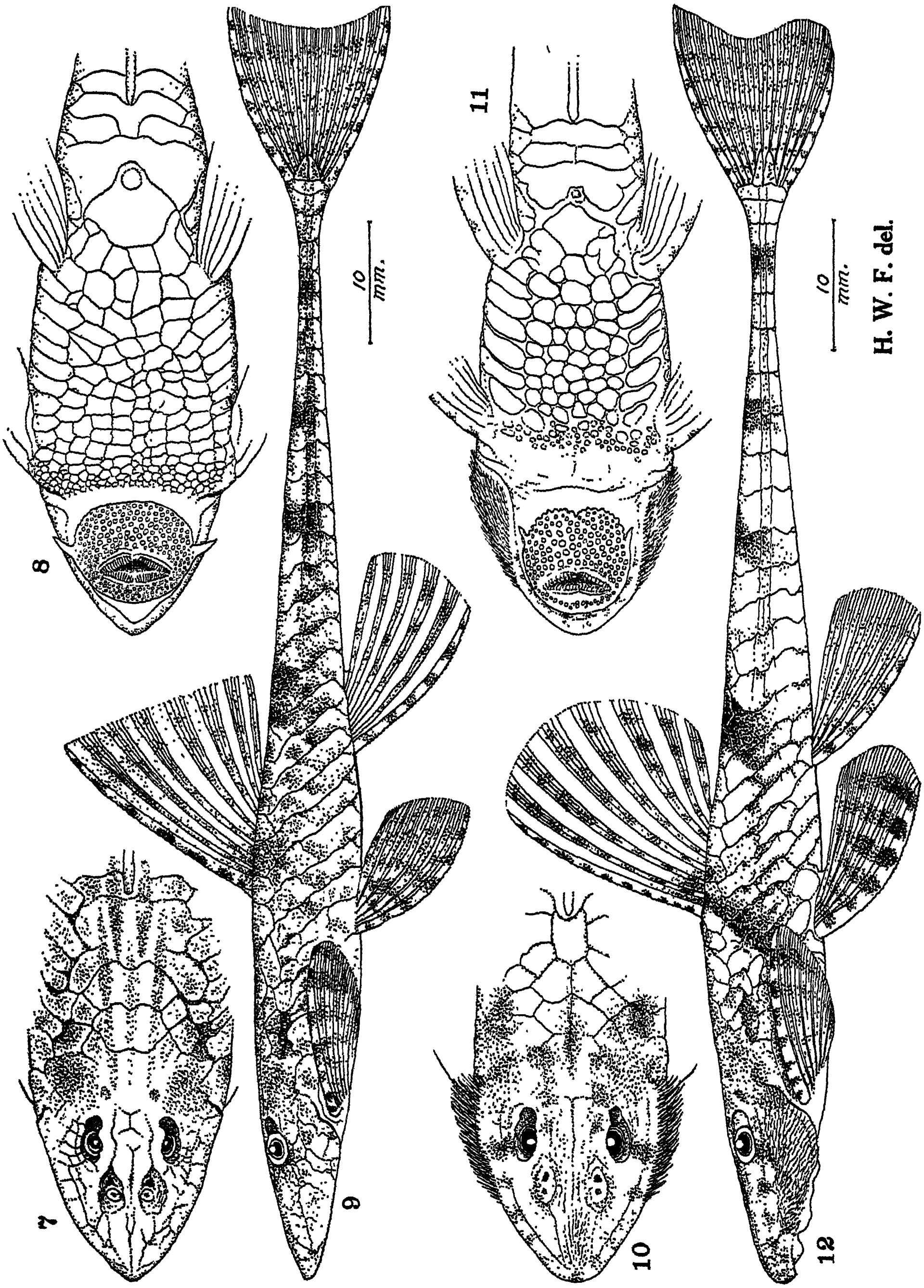
Depth $9\frac{1}{4}$ to $10\frac{1}{8}$; head measured to hind end of gill opening $6\frac{1}{8}$ to $6\frac{1}{5}$, length subequal with width, or width to $1\frac{1}{10}$ in its length. Snout (in profile) $1\frac{1}{2}$ in head; eye $4\frac{1}{5}$ to 5, $2\frac{3}{4}$ to $3\frac{2}{5}$ in snout, $1\frac{3}{5}$ to 2 in interorbital, with broad posterior notch half length of eye; mouth width $2\frac{1}{5}$ in head; buccal disk large, width $1\frac{2}{5}$, edge entire, surface papillate, short barbel each side not longer than eye; 5 to 10 slender teeth each side in each jaw; interorbital $2\frac{7}{8}$ to $3\frac{1}{4}$ in head, level. Gill opening extends forward below hind part of eye.

Scutes 17 or 18 + 11 or 12 + 1 (= 30 or 31) in lateral series; 3 large predorsal plates with posterior nearly long as combined two in front; 5 plates along dorsal base (in type bases of lateral keels to scutes obsolete and traced with difficulty, though distinct in all paratypes). Belly entirely covered with scutes (sparse to absent only in immature), 7 or 8 anteriorly or between pectoral bases and 4 posteriorly in transverse series. Scutes without any keels, all more or less rounded. On predorsal 3 parallel shallow grooves.

D. I, 7, spine terminally flexible and $4\frac{1}{8}$ to $4\frac{4}{7}$ in length of body without caudal; A. I, 5, spine like dorsal spine, its length $5\frac{3}{4}$ to 7; caudal 1 to $1\frac{1}{5}$ in head, little concave behind (in paratype wider upper rays little longer); caudal peduncle twice wide as deep, or its least width equals eye; pectoral rays I, 6, spine terminally flexible, length 1 to $1\frac{1}{10}$ in head; ventral similar, rays I, 5, spine $1\frac{1}{10}$ to $1\frac{1}{2}$ in head.

Color in alcohol brown above, very light brown to whitish below. On tail above 4 blackish brown transverse bars. Upper surface with darker brown shading on most scutes medially. Iris dark gray. Fins spotted with brown, most distinct on fin spines. On under surface of body each scute with slight diffuse median area of light brown to gray.

A.N.S.P., no. 70324. Uruguay. Dr. Florentino Felippone. Length 110 mm. Type.



FIGS. 7 to 9.—*Loricaria felipponei* new species.
FIGS. 10 to 12.—*Loricaria pareiacantha* new species.

A.N.S.P., nos. 67777 to 67782. Rio Santa Lucia, Canelones. July 1935. Length 98 to 113 mm. Dr. Felippone. Paratypes.

Related to *Loricaria catamarcensis* Berg, as described by Regan,[6] with which it may eventually be found synonymous. That species appears to differ, however, in having the lips with short marginal fringe and the predorsal scutes all carinated. Regan's description, without a figure and based on specimens but 80 mm. long, renders it impossible of identification.

(For Dr. Florentino Felippone.)

Loricaria pareiacantha new species Figures 10 (head above), 11 (head and trunk below), and 12.

Depth 9; head $5\frac{1}{2}$, width equals its length. Snout $1\frac{3}{5}$ in head; eye $4\frac{3}{5}$, 3 in snout, $1\frac{4}{5}$ in interorbital, with broad posterior notch about half length of eye; mouth width 3 to 4 in head, buccal disk width $1\frac{7}{8}$ in head, papillate, hind edge with slight median notch and entire or with smaller notches from behind each short barbel, which is much less than eye, but not developed in small specimen; 8 slender teeth each side in each jaw; interorbital $2\frac{3}{4}$ in head, broadly and slightly concave, each supercilliary only elevated over each eye. Gill opening extends forward below hind part of eye.

Scutes $15 + 13 + 1$ $(= 29)$ in lateral series; 3 moderate predorsal plates, posterior longest; 5 plates along dorsal base. Belly anteriorly covered with many very small rudimentary plates, 6 plates between pectoral bases posteriorly and posteriorly on belly 4 scutes transversely. Only on lateral scutes are pair of scutes developed on each side of body. Side of head with numerous bristle-like points, not longer than eye.

D. I, 7, spine terminally flexible and $4\frac{1}{8}$ in fish without caudal; A. I, 5, spine like dorsal spine, subequal with head; caudal similar, apparently none of rays extended, slightly emarginate behind; caudal peduncle twice wide as deep, or its least width subequal with eye; pectoral rays I, 6, spine terminally flexible, length $1\frac{1}{10}$ in head; ventral similar, rays I, 5.

Color in alcohol brown, paler to very pale brown to white below. On back 5 broad blackish transverse bands, first at front of dorsal, all others equidistant behind dorsal. Fins spotted with brown, spots most distinct on fin spines. Under surface of body immaculate.

A.N.S.P., no. 67815. Rio Santa Lucia, Canelones. March 1934. Dr. Florentino Felippone. Length 100 mm. Type.

Known only from the type, described above. Somewhat suggestive of *Loricaria steindachneri* Regan, based on the species figured by Steindachner erronously identified as *Loricaria lima* Kner,[7] especially in its bristles on the sides of the head. It differs in the presence of 4 transverse plates in the middle of the belly with 6 anteriorly, absence of keels on the plates, much shorter snout, lateral ridges approximated at nine-

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[6] Trans. Zool. Soc. London, vol. 17, pt. 3, 1904, p. 280 (Bolivia; Argentina).

[7] Denks. Akad. Wiss. Wien, vol. 44, 1882, p. 6, pl. 1, figs. 1, 2-b (Rio Parahyba at Juiz de Fora. Campos, Mendez, Rio dos Macacos, Rio Preto, Rio Quenda, Rio das Velhas, Brazil).

teenth scute in lateral series, most all fin rays distinctly black spotted and 5 black bands across the back.

(παρειά cheek + ἄκανθα spine; with reference to the slender spine-like bristles on each side of the head.)

Loricaria thrissoceps new species Figures 13 (head above), 14 (head and trunk below), and 15.

Depth $9\frac{1}{2}$; head $5\frac{1}{3}$, width of head $1\frac{1}{8}$ in its length. Snout (in profile) $1\frac{1}{2}$ in head; eye $5\frac{3}{4}$, $3\frac{2}{3}$ in snout, $1\frac{1}{2}$ in interorbital, with broad posterior notch so that combined with orbit equals interorbital width; mouth width 3 in head; buccal disk width $2\frac{1}{3}$, with rather pointed papillae, edge fringed all around and small lateral barbel much less than eye; 7 or 8 slender teeth each side in each jaw; interorbital $3\frac{2}{3}$ in head, shallowly concave, with supercilliaries each side little elevated. Gill opening entirely behind hind edge of eye.

Scutes 14 + 13 + 1 (= 28) in lateral series; 3 predorsal plates, with posterior largest or but little less than combined second and third plates; 5 plates along dorsal base. Belly completely covered with small scutes, its anterior margin sharply defined from smooth skin of under surface of head; anterior plates small, articulating, about 19 transversely and posterior to pectorals, belly with 5 transverse series of scutes. Keels developed on predorsal scutes and pair of lateral keels each side well defined, distinct, spinescent, approximating before hind end of depressed anal. Sides of head, especially all its upper surface and most of edges of fin spines, with fine slender spinules.

D. I, 7, slender spine terminally flexible, its length $4\frac{1}{3}$ in fish without caudal; A. I, 5, spine like dorsal spine, its length $1\frac{1}{3}$ in head; least width of caudal peduncle nearly $2\frac{1}{2}$ times its least depth or little less than eye; caudal lobes (damaged) subequal? with head, its hind edge little emarginate; pectoral rays I, 6, spine reaching little beyond ventral origin and terminally flexible, fin slightly less than head; ventral $1\frac{1}{7}$ in head, spine like pectoral spine, rays I, 5.

Color in alcohol brown, lighter to whitish below. Back with 4 broad blackish brown transverse bands, their arrangement and disposition as first at dorsal base and others behind dorsal. Fins brownish, all with obscure brown spots on spines and rays. Base of caudal largely dark to blackish gray. Iris dark gray.

A.N.S.P., no. 67796. Rio Santa Lucia, Canelones. March 1934. Dr. Florentino Felippone. Length 106 mm. Type.

Only the type obtained. It agrees with *Loricaria catamarcensis* Berg, as interpreted by Regan, in its papillose lips with short marginal fringes. On the contrary it differs sharply in coloration, as Regan says the body has 5 dark cross bands. The fine bristles or spines on the sides of the head are quite distinctive.

(θριξ bristle + κεφαλή head.)

Loricaria anus Valenciennes "Vieja de agua"

Two, 85 to 92 mm., Rio Uruguay, Paysandu. Scutes 24 + 9 (= 33).

CYPRINODONTIDAE

Fitzroyia lineata lineata (Jenyns)

Two, 51 to 63 mm., Costas de Punta del Este, Maldonado, February 1931 (Sr. Barattini).

One, 35 mm., Uruguay; three, 54 to 83 mm., Arroyo Malvin, Montevideo, March 1934; five, 24 to 26 mm., Arroyo Caraasco, Montevideo, fresh-water. These specimens agree with the figures of Jenyns, though their dark spots variable, different, as they are scattered over the lower sides and not arranged in definite longitudinal dark streaks at the scale junctures.

Fitzroyia lineata maculata (Regan)

Jenynsia maculata Regan, Ann. Mag. Nat. Hist. London, ser. 7, vol. 18, 1906, p. 154 (type locality, Cachi, Salta, Argentina, 2500 meters); ser. 8, vol. 11, Feb. 1913, p. 233, fig. b (outline).

Two, 38 to 51 mm., Arroyo Molles, Florida, December 1931 (Sr. Barattini). These approach Regan's outline figure but have more dark spots.

Cnesterodon decemmaculatus (Jenyns)

Four, 31 to 35 mm., Florida, Uruguay; 4 males and 3 females, 28 to 32 mm., Uruguay; fifteen, 14 to 35 mm., Arroyo Centurion, Cerro Largo, July 1932.

CORYPHAENOIDIDAE

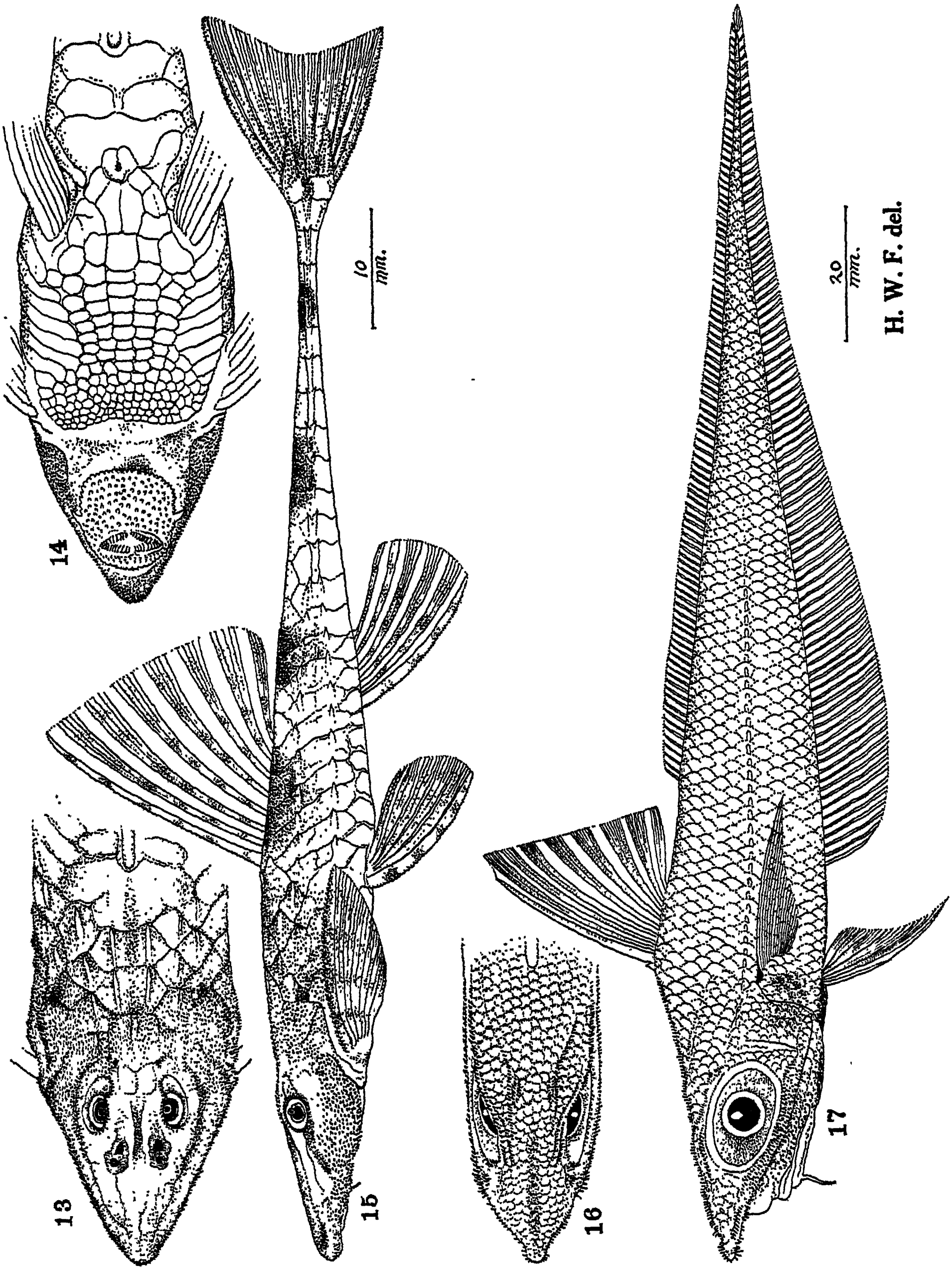
Coryphaenoides barattinii new species Figures 16 (head above) and 17.

Depth $6\frac{7}{8}$; head $4\frac{1}{3}$, width 2. Snout (in profile) to front eye edge $2\frac{7}{8}$ in head; eye $2\frac{9}{10}$, subequal with snout, greater than interorbital; orbit $2\frac{3}{7}$ in head, ellipsoid; maxillary reaches opposite hind edge of pupil, length from front end $2\frac{4}{5}$ in head; lips narrow, thin, smooth; mandibular barbel long as pupil; teeth in villiform bands in jaws, with outer row slightly enlarged; no teeth on palate; interorbital width 4 in head, concave; bones of head cavernous and with ridges finely spinescent. Gill opening extends forward opposite hind edge of orbit. Gill rakers 2 + 7, short, slender delicate denticles, barely $\frac{1}{4}$ of gill filaments, which equal $\frac{1}{4}$ of orbit.

Scales 80 in lateral line; 7 above to dorsal orgin, 6 below to anal origin; 10 predorsal scales forward to base of occipital extension. Scales very caducous, most all fallen, on head largely roughened or spinescent. Head largely scaled. Lateral line median along side, apparently distinct for not quite half way in length of tail.

D. III, 8 — 83, second spine entire, slender, little shorter than first ray, which is $1\frac{2}{3}$ in head; height of second dorsal $3\frac{1}{2}$ in eye; very small caudal $1\frac{1}{8}$, pointed behind; A. 90, highest anteriorly where fin height $3\frac{2}{3}$ in head; pectoral II, 16, reaches back nearly opposite origin of second dorsal, length $1\frac{1}{2}$ in head; ventral $1\frac{5}{6}$, rays I, 6.

Color in alcohol brown, with paler to whitish below, except on under surface of head and trunk which are blackish. Iris gray, surrounded by cream white rim or ring of eyeball. Under sides of head with black dots.



FIGS. 13 to 15.—*Loricaria thrissoceps* new species.
FIGS. 16 and 17.—*Coryphaenoides barattinii* new species.

Barbel whitish. Fins more or less grayish terminally, paler basally. Origin and axil of pectoral contrasted black.

A.N.S.P., no. 70322. Lat. 35° 8′ S., long. 52° 37′ W., off Uruguay. 1935. L. P. Barattini. Length 190 mm. Type.

Only the type obtained. Distinguished from the Patagonian *Coryphaenoides holotrachys* (Günther), the Antarctic *Coryphaenoides whitsoni* (Regan), and the *Coryphaenoides carinatus* (Günther), in the greater interdorsal space, elongated pectoral, scalation, proportions, etc.

(For Sr. Luis P. Barattini.)

Macruronus magellanicus Lönnberg

One, 440 mm., off Uruguay, 1935 (Sr. Barattini).

ACHIRIDAE

Achirus lineatus (Linnaeus) "Lenguado"

Two, 65 to 83 mm., Rio Uruguay, Frente a Paysandu, February 1933 (Sr. Barattini). Only pectoral on right side developed as 5 small feeble filaments.

ZEIDAE

Zenopsis conchifer (Lowe)

One, 215 mm., from lat. 35° 10′ S., long. 52° 10′ W., off Uruguay, 1935 (Sr. Barattini). In comparison with one 200 mm. from off Cape May, N. J., obtained in 1934 by Mr. O. H. Brown, this specimen has 8 dorsal bucklers (6 in Uruguay specimen), 5 anal (4 in Uruguay specimen), depth $1\frac{2}{3}$ ($1\frac{3}{4}$ in Uruguay specimen). The dark lateral blotch is obscure in both. Gill rakers 3 + 9 (4 + 9 in Uruguay specimen).

MACRORHAMPHOSIDAE

Notopogon lilliei Regan

Four, 155 to 175 mm., from lat. 35° 10′ S., long. 52° 35′ W., off Uruguay, August 6, 1935 (Sr. Barattini).

MUGILIDAE

Mugil brasiliensis Agassiz

One, 51 mm., Arroyo Carrusco, Montevideo, in fresh water.

SPHYRAENIDAE

Sphyraena picudilla Poey

One, 200 mm., Punta del Este, Maldonado, marine, very rare (Sr. Barattini).

ATHERINIDAE

Kirtlandia uruguayensis (Devicenzi)

Ten, 106 to 143 mm., Montevideo. A. II, 17. Scales 65 in lateral line. Six, 84 to 100 mm., Rio de la Plata.

Differs from *Kirtlandia martinica* (Valenciennes), *Kirtlandia vagrans* (Goode and Bean), and *Kirtlandia lacinata* (Swain), in its greater number of scales (43 to 48, 43, and 50 for the above species respectively). Moreover its ventrals are all more posterior or extend well beyond depressed pectoral tip. Dr. Devincenzi's description or figure do not give the lacinate or gashed edges of the scales, so well shown in these specimens.

Odontesthes perugiae Evermann and Kendall "Pejerey"

One, 96 mm., Rio de la Plata; three, 92 to 132 mm., Rio Uruguay, Paysandu; two, 161 to 180 mm., Florida, Uruguay, with A. II, 19 and scales 47 in lateral line; one, 155 mm., Rio Santa Lucia, Canelones, March 1934.

TRICHIURIDAE

Trichiurus lepturus Linnaeus

One, 410 mm., dry preparation, "Rio de la Plata a 100 millas de las costas, Uruguaya. Muy raro."

SCIAENIDAE

Pachyurus bonariensis Steindachner "Corbina"

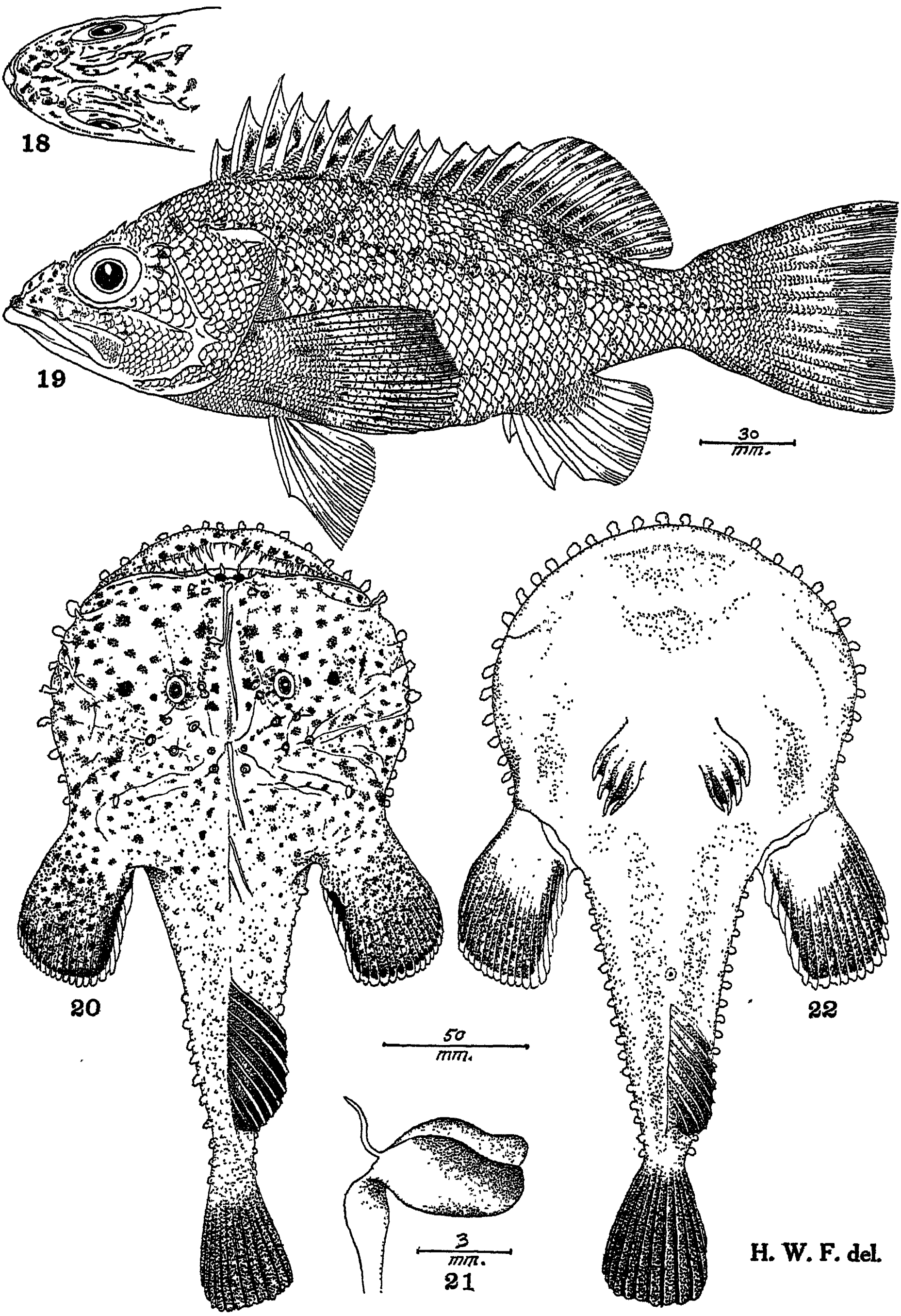
Four, 79 to 143 mm., Rio Uruguay, Paysandu, 1932.

SCORPAENIDAE

Helicolenus uruguayensis new species Figures 18 (head above) and 19.

Depth $2\frac{4}{5}$ to 3; head $2\frac{1}{2}$ to $2\frac{3}{4}$, width 2. Snout (in profile) to eye 4 in head as measured from snout tip; eye 4, subequal to slightly exceeding snout, much greater than bony interorbital; orbit $3\frac{2}{5}$ to $3\frac{1}{2}$ in head measured from snout tip; maxillary reaches opposite hind eye edge, expansion $1\frac{1}{2}$ to 2 in eye, length 2 to $2\frac{1}{5}$ in head measured from snout tip; mouth large, mandible well protruded in front; lips thin, smooth, narrow; teeth villiform, in bands in jaws, on vomer, and palatines, none on tongue; bony interorbital width $6\frac{1}{2}$ to $7\frac{4}{5}$ in head measured from snout tip, deeply concave. Gill opening extends forward opposite front rim of orbit. Gill rakers 7 to 9 + 18 or 19, lanceolate, 2 in orbit; gill filaments $\frac{3}{4}$ of gill rakers.

Armature of head with all spines low, rather small, very sharply pointed; pair of basals between front nostrils; rather low antero-orbital pair and 3 close-set pairs above upper hind orbital edge; pair of strong parietal keels, each ending in a small spine posteriorly and finally pair of small occipital spines close behind; preorbital with low, broad spine close below front edge of eye over upper front part of maxillary; suborbital stay



FIGS. 18 and 19.—*Helicolenus uruguayensis* new species.
FIGS. 20 to 22.—*Discolophius gastrophysus* new species.

with 3 keels and at hind end of second small spine opposite hind edge of eye or orbit; 5 preopercular spines, moderate; 2 wide-set opercular spines; suprascapula with 2 spines in front, one above the other and third spine little posteriorly above; postorbital keel rather high, ending behind in small spine.

Tubular scales 31 to 36 + 1 or 2 in lateral line; scales counted along (close above) lateral line 43 to 60 + 5 or 6; 8 or 9 between first dorsal origin and lateral line, 7 or 8 between second dorsal origin and lateral line; 13 below lateral line to anal origin. All fins with crowded small scales basally, except outer or hind part of ventral fin. Very small scales crowded on hind part of maxillary. Small crowded scales on chest, breast, prepectoral region, pectoral base, and humeral region. On body all scales in inclined series upward and backward, though rows still more oblique above lateral line.

D. XIII or XII, 12, third spine $2\frac{1}{5}$ to $2\frac{2}{5}$ in total head length, second ray $2\frac{1}{5}$ to $2\frac{1}{4}$; A. III, 5, second spine $3\frac{1}{8}$ to $3\frac{1}{5}$, first ray $2\frac{1}{10}$ to $2\frac{1}{4}$; least depth of caudal peduncle $3\frac{2}{3}$ to $3\frac{3}{4}$; caudal $1\frac{2}{5}$ to $1\frac{1}{2}$, slightly emarginate behind, truncate as expanded; pectoral $1\frac{1}{4}$ to $1\frac{2}{5}$, rays II, 10 + 8, lower simple ones with deeply cleft webs; ventral rays I, 5, fin $1\frac{4}{5}$ to $1\frac{7}{8}$ in total length of head.

Color in alcohol light or pale brownish (evidently bright red in life), variegated with olive-brown markings, mostly as irregular dark spots, specks, bars, and shading on head and back. Similar dark olive to blackish markings on spinous dorsal membranes, and fewer or as row of dark subbasal spots on second dorsal. Markings on other fins all very faint. Iris pale or dull gray, with variable dark spots on eyeball. Inside of gill opening blackish. Under surfaces of head and body immaculate. Fins other than noted but little marked, or immaculate.

A.N.S.P., no. 70325. Off Uruguay. Sr. L. P. Barattini, 1935. Length 275 mm. Type.

A.N.S.P., nos. 70326 and 70327. Same data as type. Length 234 to 237 mm. Paratypes.

A species apparently related to *Scorpaena lahillei* Norman,[8] but differing from the account of that species in so many details, proportions and appearance that I am unable to identify it. *Helicolenus dactylopterus* Lahille [9] shows the membranes of the pectoral in agreement with my specimens and though the pectoral base is also indicated as scaly the other fins are not so. The dark markings of the spinous dorsal and back are more in accord. Norman's description, together with his accompanying drawing by Tennison, show the following details at variance with my specimens here admitted as a new species:

1. His description gives 19 or 20 lower gill rakers from 2 specimens but 155 to 172 mm. long. In my 3 much larger specimens the lower gill rakers are 18 or 19.

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[8] Discovery Rep., vol. 16, 1937, p. 124, fig. 68 (type locality, lat. 35° S., long. 53° W., off eastern Uruguay).

[9] An. Mus. Nac. Buenos Aires, vol. 24, 1913, p. 5, pl. 2 (colored).

2. Tennison's figure differs strikingly in showing the bases of all the fins scaleless. In all my specimens they are more or less extensively scaly basally, even on the inner surfaces of the ventrals, or covered with small crowded scales.

3. On the head the scales are shown as quite small, well removed or spaced from one another and not at all imbricated, likewise on the chest, breast, prepectoral region, while those on the humeral or infrascapular region are equally as large as the others below the lateral line. My specimens have all these scales very small, greatly crowded, numerous and closely imbricated.

4. Scales between origin of spinous dorsal and lateral line shown as only 2, while in my specimens at least 7 or 8 are present.

5. Membranes of lower simple pectoral rays graduated up leaving only about $\frac{1}{3}$ of ends of rays free. In my specimens nearly $\frac{1}{2}$ of these rays are free terminally.

6. Only 2 spines shown at the suprascapula. All of my specimens have 3, with the first above a lower spine.

7. Last dorsal ray free from caudal peduncle. In my specimens this ray joined by a membrane.

8. Second dorsal fin inserted nearer caudal base than gill opening. My specimens with second dorsal origin midway between base of second or third dorsal spine and caudal base.

9. Mandible shown as but slightly protruded as closed. Well protruded in all my specimens.

10. Anal spines shown as long and slender, greatly exceeding the caudal peduncle depth. My specimens with robust anal spines but slightly greater than the caudal peduncle depth.

11. Scales shown on body below lateral line and behind pectoral with rows but little inclined from horizontal. In my specimens rows all well and clearly oblique, though less so than those above lateral line.

12. About 45 tubes indicated in the lateral line and the scale count shown about 68, 5 above to second dorsal origin, 15 below to anal origin. These counts all greatly different from mine.

13. The pattern of coloration shown is quite unlike the variegated and handsome color design of my specimens.

14. Upper side of head behind eyes and above level of its upper edge shown as scaleless, while in all of my specimens it is covered with small scales.

Further comparison with a specimen of *Helicolenus thelmae* Fowler 177 mm. long, obtained from 70 miles southeast of Cape May, N. J., in March 1940, shows that species with a scaleless maxillary and but 16 lower gill rakers.

(Named for Uruguay.)

Congiopodus peruvianus (Cuvier)

Three, 140 to 253 mm., from lat. 35° S., long. 52° W., off Uruguay, July–August 1935 (Sr. Barattini).

CICHLIDAE

Geophagus brasiliensis (Quoy and Gaimard)

Four, 70 to 90 mm., Arroyo Bornero Chico, Florida, Uruguay, November 1933; seven, 27 to 90 mm., Arroyo Centurion, Cerro Largo, July 1932; one, 73 mm. Arroyo de Malvin, Montevideo, May 1934, one 40 mm. May 6; one, 74 mm., Uruguay, 1935.

Four, 58 to 88 mm., Cautera del Ancays, Montevideo, September 1935; three, 78 to 105 mm., Rio Santa Lucia, Canelones, October 1935, two 125 to 133 mm. on October 15, one 160 mm. October 18 and two 167 to 215 mm. in 1935 (Sr. Barattini).

Crenicichla saxatilis (Linnaeus)

Two, 117 to 125 mm., Rio Santa Lucia, Canelones, March 1934, one 174 mm. on October 18, 1935 (Sr. Barattini).

GOBIIDAE

Gobiosoma parri Ginsburg

Five, 22 to 25 mm., "Puerto de Montevideo contra el caseo de umbareo." February 1932 (Sr. Barattini). D. VIII — 11 or 12.

OPHIDIIDAE

Genypterus blacodes (Schneider)

Three, 207 to 465 mm., Montevideo, 1935 (Sr. Barattini). Head $4\frac{1}{10}$ to $4\frac{3}{4}$; depth $7\frac{1}{4}$ to $9\frac{1}{4}$; eye $5\frac{2}{3}$ to 7 in head; pectoral $2\frac{1}{5}$ to $2\frac{3}{5}$.

BATRACHOIDIDAE

Porichthys porosissimus (Valenciennes) "Bagre sapo"

One, 110 mm., Rio de la Plata, 1931.

TRIATHALASSOTHIA new genus

Type.—*Triathalassothia devincenzii* new species.

Head and trunk depressed, tail compressed. Head as broad as long. Snout short, broad, depressed. Eye large, lateral, but little less than snout. Mouth broad, terminal, closed jaws equal. Maxillary reaches below eye, but not beyond it. Lips fleshy, more or less wrinkled or papillate. Teeth strong, conic, simple, erect, upper biserial, lower triserial at mandibular symphysis, become uniserial along side of jaw. Single row of strong close-set conic teeth on palate. Interorbital greater than eye, depressed, level. Opercle with 2 strong spines and subopercle with a single spine. Gill

opening lateral, rather large. Gill rakers large, short, tuberculate, few. Branchiostegals 6. Body scaleless, covered with smooth skin. Supra-orbital, maxillary and lower edge of mandible with fleshy or skinny flaps. Preopercle with large pores. Skin of suborbital, interorbital, and occipital region reticulated. Lateral line runs high along upper side of back, of small, wide-spaced and inconspicuous pores. Dorsal with 3 strong, concealed, close-set spines, just behind level of gill opening. Soft dorsal and anal opposite, free from caudal, though latter joined by membrane to caudal peduncle, and anal little shorter. Pectoral long, reaches anal. Ventral with very broad, compressed, adipose-like front margin on spine, and followed by 2 well-branched, close-set rays.

This genus appears to be intermediate between *Thalassophryne* Günther and *Thalassothia* Berg, especially in its spinous dorsal. It agrees with *Thalassothia* in the presence of maxillary teeth, the subhorizontal mouth, free caudal peduncle and more or less similar fin ray formulas.

(*τρεὶς* three, with reference to the dorsal spines + *Thalassothia.*)

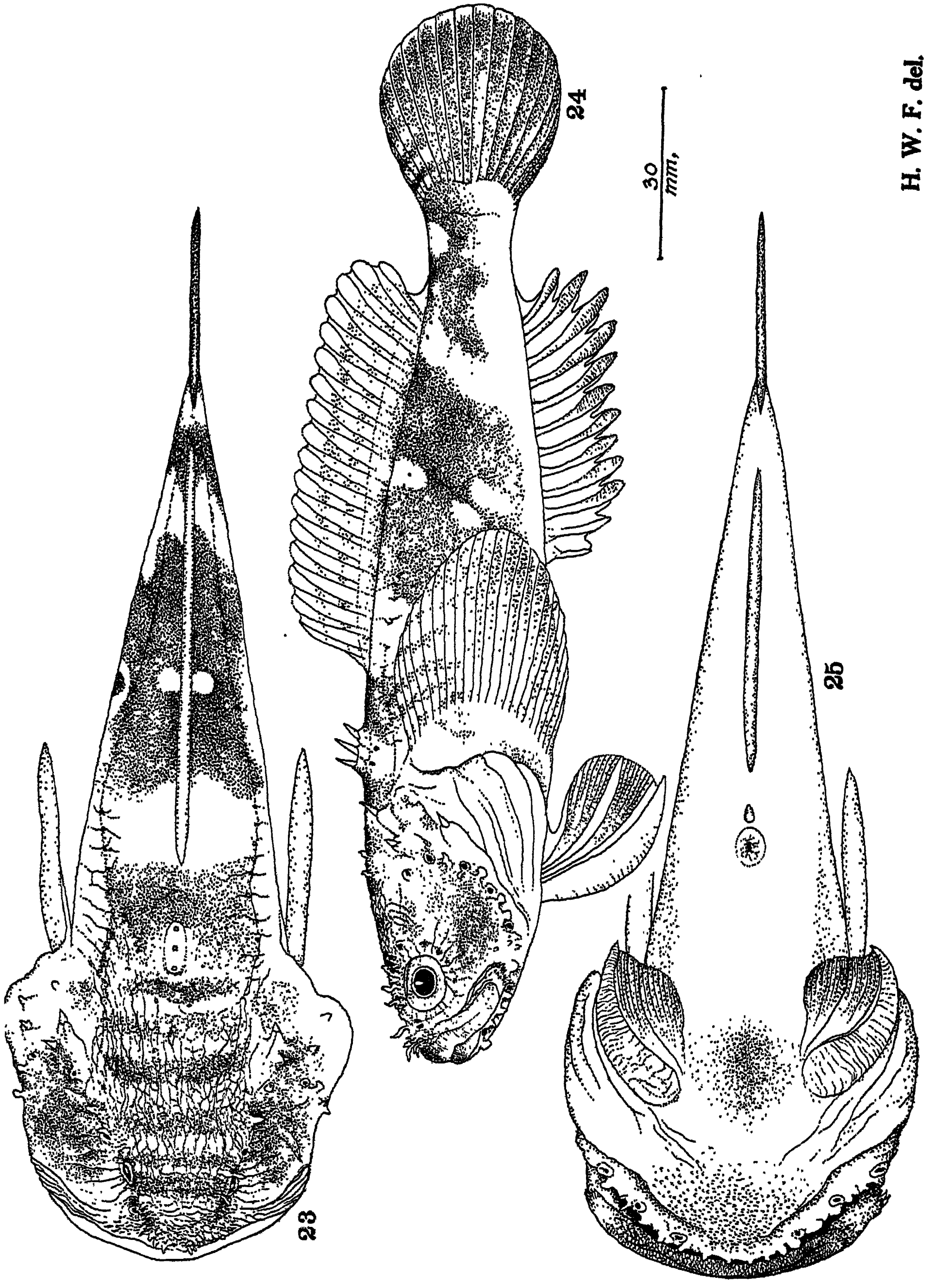
Triathalassothia devincenzii new species — Figures 23 (view from above), 24 (lateral view), and 25 (ventral view).

Depth $4\frac{2}{3}$; head $2\frac{2}{3}$, head length $1\frac{1}{8}$ in its width. Snout 6 in head, front end level with lower edge of eye; eye $5\frac{3}{4}$, subequal with snout, $1\frac{3}{4}$ in interorbital; maxillary reaches opposite middle of eye, with fleshy terminal flap opposite hind edge of eye; mouth width $1\frac{2}{3}$ in head, low; lips with inner edges all finely fringed; median upper teeth longest, dental area $\frac{2}{3}$ mouth width; lower teeth larger, stronger, close set and dental area includes entire width of lower jaw; teeth on palate like those on mandible, large and followed by broad band of large papillae; interorbital width $3\frac{1}{2}$ in head; upper or inner opercular spine larger. Length of gill opening half of head. Gill rakers $0 + 6$, spinescent low tubercles $\frac{1}{3}$ of gill filaments, which are slightly greater than eye. Pseudobranchiae small, of 3 filaments.

Skin soft and pliable. Front border or edge of snout with small tentacles or papillae, some also on supra-orbital. Pore above and behind eye and 6 small ones along lower and hind edges of eye; 2 large ones on each side of mandible and 5 on each preopercle; lateral line with 28 pores, 2 before spinous dorsal on each side. Head above with many lines and reticulations on snout, interorbital, predorsal, and fewer given off along lateral line on trunk.

D. III — 17, median spine longest or about $\frac{2}{3}$ of eye, second dorsal height 3 in head; A. 12, fin height 3, first 2 rays flexible and simple; least depth of caudal peduncle 4; caudal $1\frac{4}{5}$, rounded; pectoral rays 22, lower median longest, fin $1\frac{7}{8}$ in head; ventral $1\frac{3}{4}$, rays I, 2. Anal papilla small, short, conic.

Color in alcohol with ground color above pale brownish, below white, with creamy tint on breast and belly. On head above 7 transverse umber-brown bands, of which 2 extend across interorbital. Transverse umber band across interdorsal space. Second dorsal with 2 broad umber bands, united below lateral line. Two transverse umber blotches on caudal peduncle, more or less connected on its sides. Iris gray. Dorsals pale



FIGS. 23 to 25.—*Triathalassothia devincenzii* new species.

brown, second dorsal slightly grayish or dull brown on rays. Anal similar. Caudal brown, slightly darker terminally. Pectoral brown. Ventral with broad fleshy first ray or spine cream-white, branched rays pale, grayish terminally.

A.N.S.P., no. 70373. East-southeast of Dupa de lobos 420 miles, in 80 feet. 1935. Sr. L. P. Barattini. Length 185 mm. Type.

Only the type obtained. Characters of the species and distinctions largely contained in the generic account already given. *Thalassothia montevidensis* Berg[10] is described and shown with 4 dorsal spines, in 2 pairs and the posterior pair close before the second dorsal fin. The anal is given as 2, 14, and the pectoral 16. Comparison with the figure, a drawing, shows the head smaller, the pointed pectoral with upper median rays longest and reaching opposite the anal origin, different and smaller ventral, lower second dorsal and anal, greatly smaller caudal, a different lateral sensory system, and different coloration, with 2 black spots behind the gill opening in the prepectoral region.

Two photographs of a dorsal view by Devincenzi[11] are quite imperfect. Compared with my specimen they both show a feature entirely different in the second dorsal and anal encroaching on the base of the caudal fin. The pectoral fin also shows the upper median rays apparently longest, the origin of the second dorsal much nearer the caudal base than the tip of snout, a much smaller eye, no transverse dark bands clearly shown on the upper surface of the head and the dark blotches on the back while similarly located are differently defined so far as the imperfections of the photograph reveal. Finally Devencenzi[12] has given a figure which shows still greater diversity, especially in the dark oblique band down and back from the eye, the very short caudal peduncle with which the last dorsal and anal rays are entirely connected and therefore extending posterior to the caudal base, apparently with a single opercular spine, the upper pectoral rays longest, a different shaped ventral fin and the dorsal rays II — II, 16 and the A. 16.

(For Dr. Garibaldi J. Devincenzi, for his many works on the fishes of Uruguay.)

LOPHIIDAE

DISCOLOPHIUS new genus

Type.—*Lophius gastrophysus* Ribeiro.

Head, as measured to hind end of pectoral base, subequal to little broader than long. Snout broad, its length to front edge of mouth ¼ or

[10] Anal. Mus. Nac. Buenos Aires, vol. 4, 1895, p. 67, pl. 2 (type locality, Montevideo, Uruguay).

[11] Anal. Mus. Nac. Montevideo, 1924, p. 258, pl. 20 (lower photograph) and 21 (lower photograph).

[12] Album Ict. Uruguay, 1940, pl. 39, second figure from top.

more in greatest width of body. Teeth in lower jaw in 3 rather irregular series. Bony interorbital width rather narrow, less than subequal with snout length. Marginal skinny flaps of body moderate. Bait bilobate, with single filament. Young spotted above with dark or blackish.

The above characters largely distinguish this genus from *Lophius*, in which it has been included.

(δισκος disk + *Lophius*.)

Discolophius gastrophysus (Ribeiro) Figures 20 (dorsal view), 21 (bait), and 22 (ventral view).

Lophius gastrophysus Ribeiro, Arch. Mus. Nac. Rio de Janeiro, vol. 17, 1915, Pediculati, p. 2, pl. (photograph), p. 4 (outline of ventral view) (type locality, coasts of Brazil).—Devincenzi, Anal. Mus. Montevideo, 1924, p. 282, pl. 24 (photograph) (Bahia de Maldonado).—Devincenzi and Legrand, Album Ict. Uruguay, 1940, pl. 52 (lower figure).—Fowler, Arquiv. Zool. São Paulo, vol. 3, art. 6, 1941, p. 184 (reference).

Depth $8\frac{1}{5}$ to $9\frac{1}{4}$; head as measured to gill opening on under side of body $2\frac{1}{3}$ to $2\frac{2}{3}$; width $1\frac{4}{5}$. Snout very broad, length as measured from front edge of mouth to hind basal edge of pectoral 3 to $3\frac{2}{5}$; eye $3\frac{1}{5}$ to $3\frac{1}{4}$ in snout as measured to front border of mouth, $3\frac{1}{4}$ to $3\frac{1}{3}$ in interorbital width; maxillary $2\frac{1}{10}$ to $2\frac{1}{5}$ in head measured to hind basal edge of pectoral; lips little fringed marginally; lower teeth irregularly biserial to triserial; gill opening entirely ventral.

Skin smooth. All around edge of disk row of skinny flaps, variable, sometimes as several irregular rows along each side of tail. On head above a number of short strong spines; close-set pair each side of base of bait; pair of close-set supra-orbital spines over each eye and row of small obtuse spines forward on each rostral extension toward median front end of snout; pair of strong postorbital spines each side of median line, with small spine each side of base of third dorsal fin spine, and still posterior another larger pair; pair of spines little external and posterior to each pair of postorbital spines; spines behind end of each maxillary; 3 along each preopercle with another marginal and still posterior; strong humeral spine each side.

D. II — III — 9, first spine shorter than snout and with bilobate bait surmounted by a filament; A. 10, similar to and opposite second dorsal; caudal long as combined eye and snout, truncated; pectoral 19, long as space between front edge of mouth and base of third dorsal spine; ventral rays 5, fin length subequal with interorbital space.

Color in alcohol brown above with many variable or obscured darker brown spots, mostly small and less numerous on tail. Very small dark spots crowded on upper surfaces of pectoral and caudal fins, and on former edges whitish next to a dark or blackish submargin. Iris grayish. Inside mouth pale to whitish. Dorsal dark brown. Under surface of body whitish, though all of fins more or less dark to blackish brown terminally. Marginal or skinny flaps all more or less brown.

Two, 278 to 283 mm., lat. 35° 10′ S., long. 52° 35′ W., August 6, 1935 (Sr. Barattini).

ABSTRACT OF MINUTES OF THE PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA

FEBRUARY 16, 1943

Annual Meeting of the Academy.

Twenty-six members and guests present.

President Charles M. B. Cadwalader in the Chair.

Annual report for the year 1942 was presented by the President. This report covered the work of all the scientific departments, as well as the Library, Educational, Museum Exhibits and Photographic Departments.

The Treasurer also made a report covering the finances of the institution.

During the year a total of 140 new members were elected to the Academy in the following classes: Life, 2; Contributing, 1; Annual, 113; Non-Resident, 1; Junior, 23.

Changes in membership since the last report were presented as follows: Contributing to Annual, 1; Contributing to Life, 1; Life to Associate Sustaining, 4; Sustaining to Benefactor, 1; Junior to Annual, 2.

During the year 1942 the Academy lost 50 members by death.

Following their nomination as prescribed by the By-Laws of the Academy, the following individuals were elected members of the Board of Trustees for the period extending to the Annual Meeting, 1946: Charles M. B. Cadwalader, R. Meyer de Schauensee, Brooke Dolan, II, Henry S. Drinker, Thomas S. Gates, J. Stogdell Stokes.

ELECTION OF OFFICERS

At a meeting of the Board of Trustees of the Academy held March 8, 1943, the following officers were elected:

President: Charles M. B. Cadwalader
Managing Director: Charles M. B. Cadwalader
Vice President: Edwin G. Conklin
Vice President: R. Meyer de Schauensee
Treasurer: Arthur E. Newbold, Jr.
Assistant Treasurer: John E. Bowers
Secretary: John E. Bowers
Corresponding Secretary: James A. G. Rehn

INDEX TO THE GENERA AND SPECIES DESCRIBED AND REFERRED TO

New Species and Genera are Indicated by Bold Face Numerals